



**HAL**  
open science

## The New and the Old: re-excavations at Abri Cadet 3, Marie Galante

Arnaud Lenoble, Corentin Bochaton, Laurent Charles, David Cochard,  
Patrice Courtaud, Katarina Jacobson, Brice Ephrem, Monica Gala, Véronique  
Laroulandie, Miriam Mesa, et al.

► **To cite this version:**

Arnaud Lenoble, Corentin Bochaton, Laurent Charles, David Cochard, Patrice Courtaud, et al.. The  
New and the Old: re-excavations at Abri Cadet 3, Marie Galante. 2023. halshs-04559277

**HAL Id: halshs-04559277**

**<https://shs.hal.science/halshs-04559277v1>**

Preprint submitted on 25 Apr 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

## The New and the Old: re-excavations at Abri Cadet 3, Marie Galante

Authors: Arnaud Lenoble<sup>1\*</sup>, Corentin Bochaton<sup>2</sup>, Laurent Charles<sup>3</sup>, David Cochard<sup>1</sup>, Patrice Courtaud<sup>1</sup>, Katarina Jacobson<sup>4</sup>, Brice Ephrem<sup>5</sup>, Monica Gala<sup>1</sup>, Véronique Laroulandie<sup>1</sup>, Miriam Mesa<sup>1</sup>; Caroline Partiot<sup>1</sup>, Nathalie Serrand<sup>6,7</sup>

<sup>1</sup> – PACEA – UMR CNRS 5199, Université de Bordeaux, 33 615 Pessac, France

<sup>2</sup> – Max Planck Institute for the Science of Human History, 07745 Jena, Germany

<sup>3</sup> – Muséum d'Histoire Naturelle de Bordeaux, 33000 Bordeaux, France

<sup>4</sup> – Musée Edgar Clerc, Conseil départemental de la Guadeloupe, 97 160 Le Moule, Guadeloupe, France

<sup>5</sup> – Ausonius – UMR CNRS 5607, Université Bordeaux Montaigne, 33607 Pessac, France

<sup>6</sup> – Institut National de Recherche archéologiques préventives, 97 113 Gourbeyre, Guadeloupe, France

<sup>7</sup> – UMR CNRS 7209 Archéozoologie-Archéobotanique, muséum d'Histoire naturelle de Paris, France.

\* Corresponding author : arnaud.lenoble@cnsr.fr

**ABSTRACT** — The Abri Cadet 3 in Marie Galante was firstly excavated in 2004. The stratigraphy documents the latest Pleistocene and the second half of the Holocene. An archaeological level of the late Ceramic period was evidenced, as well as older levels, rich in bones and invertebrate remains, for which the question of a human contribution to the assemblage formation was raised.

New excavations were carried out in 2018 and 2019 with three perspectives: 1) increase the vertebrate assemblage to describe the succession of Holocene vertebrate biocenoses on the island, 2) precise the chronology of the deposit and refine the stratigraphic resolution of the collected material, and 3) collect evidence for discussing a human use of the site during the Archaic age.

These new excavations revealed the funerary function of the site during the final Ceramic period with the finding of an Amerindian burial in the highest part of the deposit. They also demonstrate the Archaic occupation of the shelter as early as 3,000 BCE, by highlighting small combustion features and tiny flint flakes. The preliminary study of both vertebrate and invertebrate faunal remains also allows to further discuss the question of animal exploitation by Archaic people in this site.

### **RESUME - Du neuf et du vieux : reprise de fouilles de l'abri-sous-roche de Cadet 3, Marie-Galante.**

L'abri-sous-roche de Cadet 3, à Marie-Galante, a été sondé en 2004. Il livre une séquence documentant la partie finale du Pléistocène et la seconde moitié de l'Holocène. Un niveau archéologique d'âge céramique récent y a été reconnu, ainsi que des niveaux plus anciens, riches en ossements et restes d'invertébrés, pour lesquels s'est posé la question d'une contribution humaine à la constitution des dépôts.

La fouille du site a été reprise en 2018 et 2019 avec trois perspectives : 1) augmenter l'assemblage vertébré pour décrire la succession des biocénoses vertébrées holocènes de l'île,

2) préciser la chronologie du dépôt et affiner la résolution stratigraphique des assemblages collectés et, 3) recueillir des éléments permettant de discuter la fréquentation humaine au cours du Précéramique.

Les nouveaux travaux font apparaître la fonction funéraire du site à l'époque céramique tardive via la mise au jour d'une sépulture amérindienne dans la partie la plus sommitale du dépôt. Ils démontrent également l'occupation précéramique de l'abri dès 3 000 ans avant notre ère, par la mise en évidence de petites structures de combustion et d'un petit assemblage microlithique, tous deux inclus dans une couche documentée par de nouvelles datations radiocarbone. L'étude préliminaire des restes fauniques vertébrés et invertébrés permet, enfin, de discuter plus avant la question restée en suspens à l'issue du précédent sondage, à savoir la fraction des assemblages vertébrés et invertébrés imputable à l'occupation précéramique.

### **RESUMEN - Lo nuevo y lo antiguo: retomando excavaciones en el abrigo de Cadet 3, Marie-Galante.**

El abrigo de Cadet 3 en Marie-Galante fue excavado por primera vez en 2004, descubriendo una estratigrafía que cubre la parte final del Pleistoceno y la segunda mitad del Holoceno. Un nivel arqueológico de Edad Cerámica tardía fue documentado, así como niveles más antiguos, ricos en huesos y restos de invertebrados, en los cuales se plantea una contribución humana en la formación de los depósitos.

La excavación del yacimiento se retomó en 2018 y 2019 con tres perspectivas de trabajo: 1) aumentar el conjunto de vertebrados para describir la sucesión de biocenosis de vertebrados holocenos en la isla, 2) precisar la cronología del depósito y afinar la resolución estratigráfica de los conjuntos recuperados y, 3) recoger elementos que permitan debatir la frecuentación humana del yacimiento durante la Edad Prececerámica.

Los nuevos trabajos revelan la función funeraria del yacimiento durante el periodo Cerámico tardío con el descubrimiento de una sepultura amerindia en la parte superior del depósito. Se demuestra también la ocupación prececerámica del abrigo desde 3.000 AC, con la descubierta de pequeñas estructuras de combustión y un pequeño conjunto microlítico, ambos incluidos en una capa documentada por nuevas dataciones radiocarbónicas. El estudio preliminar de los restos faunísticos vertebrados e invertebrados ofrece la posibilidad de discutir más en detalle la cuestión que estaba en suspense desde la primera excavación, sobre la fracción de los conjuntos de vertebrados e invertebrados atribuibles a la ocupación prececerámica.

## 1. Introduction

The Abri Cadet 3 is a rockshelter located in an old cliff distant about a hundred meters of the shoreline on the southern coast of Marie Galante (N15°52'55"; W61°14'6.07"). This area contains many caves and evidences of pre-Columbian occupation (Fig. 01). The Abri Cadet 3 is located back from the Troumassoid village of Petit Anse (Lenoble 2014; Casagrande 2013). It is also contiguous to the grotte Cadet 2, a funeral cave in which human bones from the late Ceramic period were found (Courtaud 2011). A little further west on the same cliff lies the grotte du Collier, where a pre-Columbian burial with associated ornaments was damaged about fifteen years ago, and some hundred meters further east the grotte Blanchard, which is a major paleontological site of the island (Baillon *et al.* 2015; Stoetzel *et al.* 2016b; Royer *et al.* 2017) as well as a cave occupied in the late Ceramic period (Courtaud *et al.* 2014).

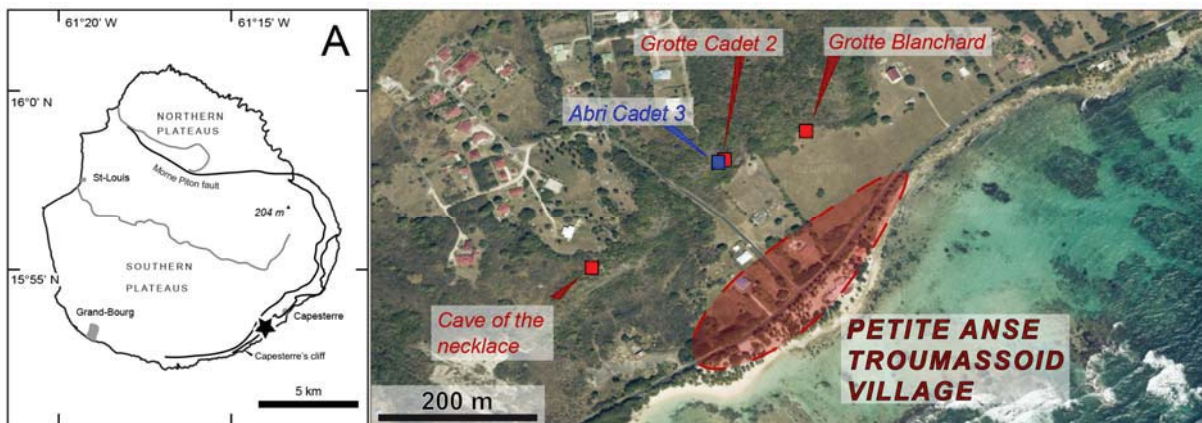


Fig. 01: A - Location of the site (black star) on the Marie Galante map and, B - on a close-up view of the Petite Anse area, with indication of nearby pre-Columbian burial caves (red squares).

The Abri Cadet 3 was excavated in 2004 by Christian Stouvenot who reported on it at the 24th IACA congress (Stouvenot *et al.* 2013). The excavation consisted of a test pit that reached a depth of 1.2 m. The sediment was dry sieved on the site with a fine mesh (2.5 mm) and the material of interest selected from the screen. The deposit was subdivided in three main units and eleven layers. The upper part of the stratigraphy corresponds to a brown colluvium composed of a carbonated loamy sand in which are interspersed traces of a Ceramic occupation: charcoals lenses, sherds, and a few bones. Ceramic style and radiocarbon dating indicate a Troumassoid occupation. Below it lies a 0.4 m thick unit of carbonated sand including many limestone granules and stones alongside numerous land snail shells, crab claws, and bones. According to the radiometric datations obtained during these excavations, this unit was formed between the first and third millennia before the Common Era. The excavation report states that a human presence in this unit is suggested by several clues, though no artefacts were found while the faunal study concludes to a primarily if not exclusively natural accumulation (Stouvenot *et al.* 2013). The base of the deposit is formed of fine yellowish to reddish carbonated sand containing numerous bones accumulated by raptor. This unit is dated to the late Pleistocene.

A new phase of investigations was initiated in relation with the ECSIT project (Ecosystèmes insulaires tropicaux : réponse de la faune indigène de Guadeloupe à 6 000 ans d'anthropisation du milieu). This project aimed to identify extinct and extirpated terrestrial animal species of the Guadeloupe islands, focusing on the link between species losses and human societies that inhabited the islands. The first objective of the new excavations at Abri Cadet 3 was thus to provide a well-documented series of the terrestrial fauna contained in the deposit.

The results presented in this paper are not, however, those sought in this objective, but new archaeological results that derive from the excavation method implemented in regard to the paleozoological objective of the project. Three points were thus documented during this new phase of excavation: The funerary use of the site at the final Ceramic period, the occupation of the site in the Archaic age, and the subsistence of Archaic people.

## 2. Method

The excavation was executed in two phases: a first phase in June 2018, and a second in January 2019. The excavation area was limited to 1,5 m<sup>2</sup>, in order to allow an exhaustive collect of the archaeological and paleontological data. Five sub-squares of 0.5 m<sup>2</sup> were excavated, immediately adjacent to the 2004 excavation pit (Fig. 02). This choice to allow a stratigraphic control during the excavation, and the pit of the 2004 excavation was first hollowed out for this purpose. Each stratigraphic unit was excavated according to the geometry of the sedimentary bodies subdivided in arbitrary levels of about 3 cm. The sediment was water-sieved in the field through a pair of screens (2 and 5 mm). The sieve residue was dried and sorted in the field lab to ensure that all archaeological and faunal remains were collected. In addition, the volume of fine earth (i.e. sediment without stones by dry pre-sieving with a 10 mm mesh) was measured for each sample, in order to establish the concentration of collected items.

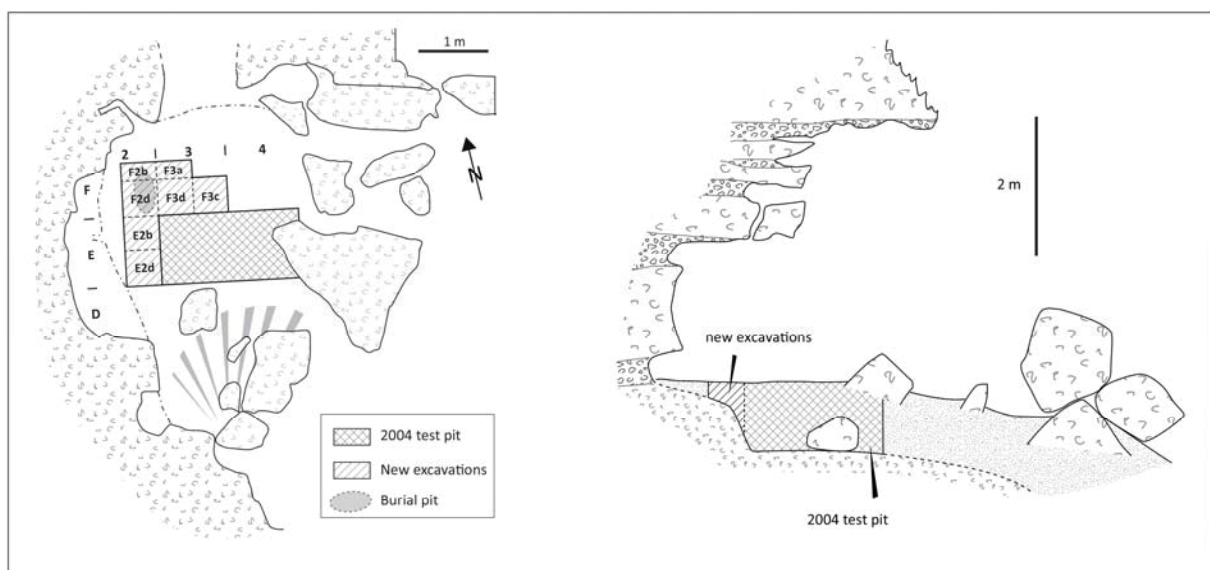


Fig. 02: Plan and section of the shelter with location of the 2004 survey and the new excavations.

Finally, the half-sub-square where the stratigraphy appeared to be the most detailed (sub-square F3c) was selected to obtain a stratigraphic column. The sorting of the sieving residues of this half-sub-square was exhaustive, which means that all the charcoals, snail shell, crab exoskeleton or bone fragments were recovered to allow a weight quantification of these fractions.

New dates were also performed to refine the age of the deposit. Charcoal was preferred as a material, selecting twig fragments or fragments of the cortical tissue of branch to prevent any old wood effect (Stouvenot *et al.* 2015). Radiometric ages were calibrated with the CALIB rev. 8 (Stuiver & Reimer 1993) and the Intcal20 curve (Reimer *et al.* 2020). An additional age was obtained by dating the collagen of a human bone, the result being calibrated with a mixed calibration curve assuming a 33% contribution of marine carbon as usual for late Ceramic populations (Bochaton *et al.* this volume; Pestle & Laffoon 2018); and a regional correction value of the marine reservoir (dR) of -146 +/- 114 yr (DiNapoli *et al.* 2021). In this paper, the calibrated ages are expressed in calendar years of the Common Era (CE) or Before the Common Era (BCE).

### 3. Results

#### 3.1 [Stratigraphy and chronology](#)

The same three main stratigraphic units were found, hereafter named upper, median and lower members (Fig. 03). However, the stratigraphic analysis based on sedimentary and pedological features led to consider only 6 layers (Tab. 01). Moreover, the excavation also showed that the chromatic and textural variations of the summit part of the lower member expressed an alteration of the deposit by accumulation of phosphates, in relation with a sedimentation gap. While two layers were differentiated during the excavation (layer 5 and layer 6), this distinction has no stratigraphic value, the reason why the material from these layers was grouped into a single lot during the study.

A few ceramic sherds were collected in the layer 2, shaped with a coil form method, and processed with a more or less careful smoothing and partial red colouring. This material is not very diagnostic, but it is consistent with the Troumassoid attribution of the sherds recovered in previous excavation.

More significantly, the new excavations clarify the formation processes of the median member, with an organic paleosol at the base (layer 4) covered by a poorly stratified sediment including lenses of sorted material and erosional features (layer 3). The upper part of the middle member (layer 3) was described as deposits formed by the extension of a colluvial fan into the shelter (Stouvenot *et al.* 2013). The sedimentary structures observed during the new excavations: lenses of gravel or stone indicative of a sedimentation by alternating events of debris flows and runoff, are consistent with this interpretation. This sedimentary processes also reflect an intermittent sedimentation accompanying major climatic events such as storm rain or cyclone or intense rainfall on deforested land, while chronological gaps occur between the different sedimentation events (Bertran & Cousot 2004). Moreover, the sorting of faunal remains and charcoals contained in the gravel and stone lenses could indicate that some of these elements were removed during sedimentation.

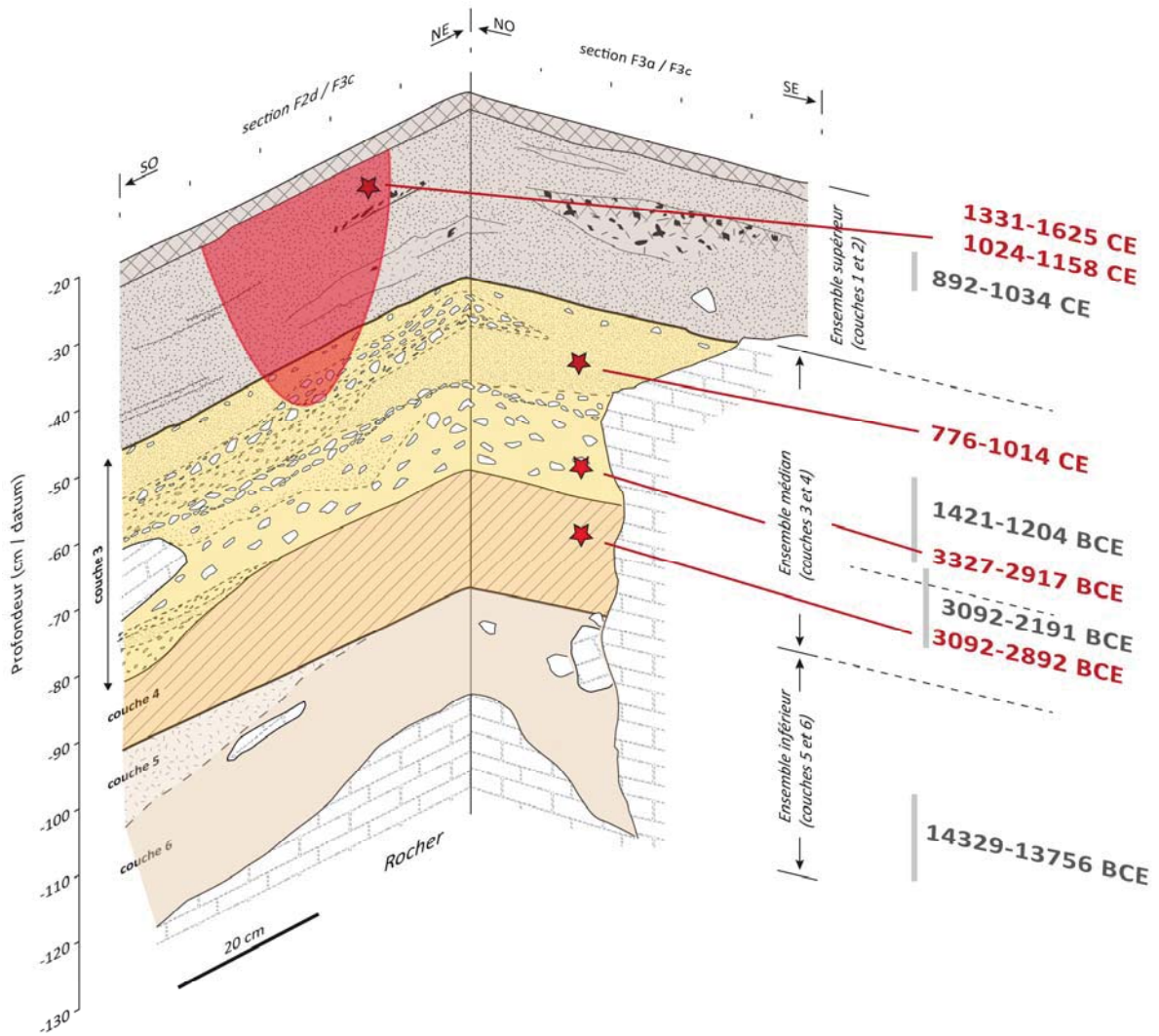


Fig. 03. stratigraphy of the site following the new excavations with dates obtained from the 2004 survey (gray) and the new excavations (red).

Member	Layer	2004 units	Description	Formation process
Upper	1	A		Trampling
	2	B-D	Loose grey-brown to brown silty sand, containing sub-centimetric calcareous granules and supra-decimetric lenses of ashy sediment or charcoal	Colluvion
Intermediate	3	F-H	Matrix-supported brown to light grey loose silt, rich in granules, small calcareous pebbles, crab and gastropod shells, including lenses of poorly sorted pebbles.	Debris flow & runoff
	4	I	Dark grey to brown silt with fine sands	Paleosol
Lower	5	J	Massive cream-colored silt slightly indurated	Alteration (decarbonization + phosphatization)
	6	K	massive reddish-brown to yellowish-brown calcareous sandy silt, rich in vertebrate bones	Runoff deposit

Table 1. Lithostratigraphy of the Abri Cadet 3.

2004 and 2019 excavations yield a series of nine radiocarbon dates (Tab. 02). The layer 3 date following the 2004 excavations was performed on charcoal. As such, the result appears reliable. But the date of layer 4 was carried out on a sample of several bones associating species with terrestrial and marine diet. This date thus averages the age of the different individuals represented in the sample of bones. In addition, the proportion of marine carbonates remains unknown, resulting in a very large confidence interval of the calibrated age.

The new dates clarify the age of the median member layers. The associated precision results from the material used (single element of charcoal) as well as to the fine stratigraphic localization of the samples thanks to the subdivision of the stratigraphic units into thin levels (Fig. 03 & Tab. 02). The calibrated ages show that the middle part of layer 4 and the base of layer 3 are indistinct, formed at the transition between the 3rd and 4th millennia BCE, while the uppermost part of layer 3 is dated at the end of the first millennium of the common era. The formation of the intermediate member thus extends over several millennia, coinciding with the Archaic age (layer 4 and lower layer 3) and the early Ceramic period (upper layer 3).

### 3.2 Burial of the final Ceramic period

The single burial of a pre-Columbian child was found in the rear part of the shelter. The individual was interred in a narrow pit, 60 by 40 cm (Fig. 02) with no associated potsherd nor any grave good. The pit is posterior to the Troumassoid level, crosscutting it. Moreover, the radiocarbon datation of a skeletal remain places this burial between the 14th and 16th centuries (Tab. 02), i.e. a few decades before or shortly after C. Columbus reached the Lesser Antilles. In contrast, a charcoal included in the filling of the pit is dated to the 11-12th century, that is to say, a few centuries older than the human. An old-wood effect produced by dating a long-lived tree species is excluded since the charcoal selected for dating was a fragment of cortical tissue. But it can't be excluded that the wood used as fuel is old dead wood (stump or driftwood).

The skeleton is complete, although the bones were rather fragile due to postdepositional alteration. The position and anatomical relation between the bones point to a primary interment of a child, with an age at death estimated to be between 4 and 6 years based on dental mineralization (Moorrees *et al.* 1963), and a stature to be approximately 1m (Cardoso 2009).

The body was positioned in supine position with hands on the abdomen and the legs flexed towards the torso (Fig. 04A). The absence of bone displacements outside the soft tissue volume of the body, as well as skeletal elements preserved in unstable positions indicate a burial in the ground with rapid filling of the spaces left vacant by the decomposition of the soft parts. However, wall effects and constraints deduced from the non-natural position of the bones (right humerus tipped medially, head tilted anteriorly against the thorax, marked wall effect at the level of the feet, Fig. 04B-D) indicate that the individual was deposited in a body container such as a shroud or a basket. Finally, lenses of fresh charcoal and ash in the upper part of the pit attest to the remobilization of combustion structures during the filling of the burial.



Year	Layer	Subsquare / Decapage	Depth range / Datum (cm)	Material	Lab code	Age <sup>14</sup> C BP	Calibration Curve	Calibrated age range CE/BCE (2 sigma)
2019	Burial pit	F2b	-	Human bone	Lyon-16850 (SacA-57857)	600 ± 30	Mixed 20	1331-1625 CE
2019	Burial pit	F2b4	-	charcoal (cortical tissue)	Lyon-16849 (SacA-57856)	965 ± 30	Intcal 20	1024-1158 CE
2004	2	E3-F1	-28 to -52	charcoal	Erl-10159	1056 ± 36	Intcal 20	892-1034 CE
2019	3	F3c13	-58.8 to -61.5	charcoal (twig fragment)	Lyon-16851 (SacA-57858)	1110 ± 30	Intcal 20	776-1014 CE
2004	3	E3-C6	-64 to -77	charcoal	Erl-10156	3052 ± 41	Intcal 20	1421-1204 BCE
2019	3base	F3c 18	-73 to -76	charcoal	Lyon-15658 (GrM)	4420 ± 35	Intcal 20	3327-2917 BCE
2004	4	E3-C7	-77 to -89	lot of bones <sup>1</sup>	Erl-10157	4350 ± 44	Mixed 20 <sup>2</sup>	3092-2191 BCE
2019	4	F3c21	-83.5 to -87	charcoal	Lyon-15657 (GrM)	4375 ± 35	Intcal 20	3092-2892 BCE
2004	6	C3-C9	-89 to -118	lot of Herp bones <sup>3</sup>	Erl-10158	13299 ± 97	Intcal 20	14329-13756 BCE

Table 2. <sup>14</sup>C datations for the Abri Cadet 3.

1 The bone batch mix species with terrestrial and marine diet

2 the calibration includes the uncertainty of the marine carbonate content, ranging from 0 to 100%.

3 on organic residue (collagen not-preserved)

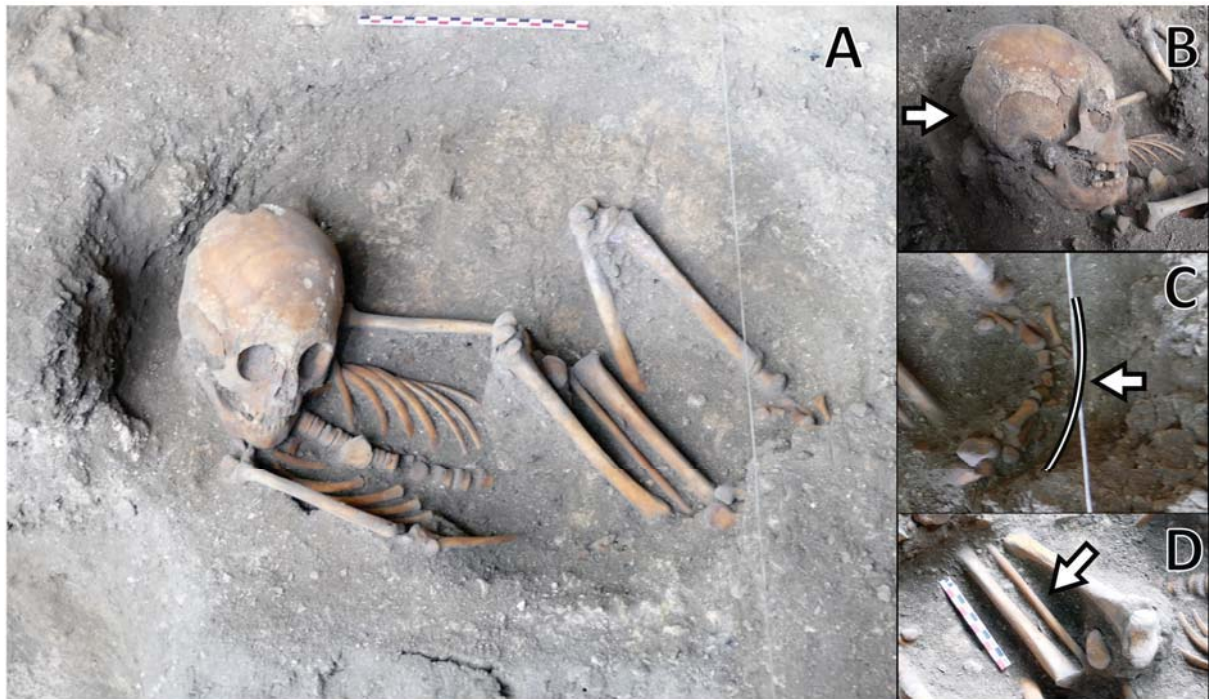


Fig. 04. A - view of the final Ceramic burial; B, C, D – details

### 3.3 [Archaic occupation of the site](#)

Fine-mesh water sieving allowed the recovery of very small elements attributable to human use of the site, i.e. flint flakes and charcoals.

Two small flint flakes (ca. 1 cm) were found in the median member (layer 4) during the 2004 test pit. This small number of pieces, combined with the possibility of intrusive objects, led to them not being taken into account when interpreting the median member formation (Stouvenot *et al.* 2013). This number has been greatly increased by the use of water screening. A total of 37 flint flakes were found in the course of the new excavations. These are mostly flakes less than 1 cm in size (Fig. 05). Different types of materials are represented, including honey-colored flint, light grey flint, jasper, and siliceous limestone. The flakes were produced by hard hammer direct percussion. Some of them have sharp edge, although a microwear analysis (observation at x10 to x500 magnification) indicates that these artefacts were not used: despite the good preservation of the surface, no traces of wear are identified. It is therefore believed that these chips are not wanted products, but by-products of tool manufacture or tool reshaping. These flint flakes are found in layers 1 to 4. They are present from the base of the median stratigraphic member (layer 4, Fig. 05). It is even in the median member that they are the most numerous (20 of the 37 recovered flakes). Furthermore, the elements contained in layer 3 were found in a stratified sediment in which no burrows or cavities formed by root decay were observed, thus ruling out the possibility of intrusion of recent elements.

The charcoals collected in the site take several forms. The complete collection of sieve refuse also makes it possible to establish the relative quantity of charcoal in the different stratigraphic units (Fig. 06). The charcoals are numerous in the ceramic level (layer 2), where they are large in size and fresh in appearance, and can form well-circumscribed charcoal lenses. They are also present in the median member, but in the form of small to

medium sized, sorted charcoal fragments contained in the stony lenses of layer 3, and in the form of very small charcoals grouped within small combustion structures in layer 4. These features, 10 to 15 cm in diameter, rich in grey ash, were only observed at the rearest part of the site. They may not have been preserved elsewhere, possibly in relation to water drips in the shelter. It could nevertheless be observed that these lenses are present at different depths in layer 4 (Fig. 06). A thin section taken in one of these carbonaceous lenses confirms the in situ character of these combustion features, while revealing that the associated ash is largely altered (recrystallization of carbonates) due to leaching processes.

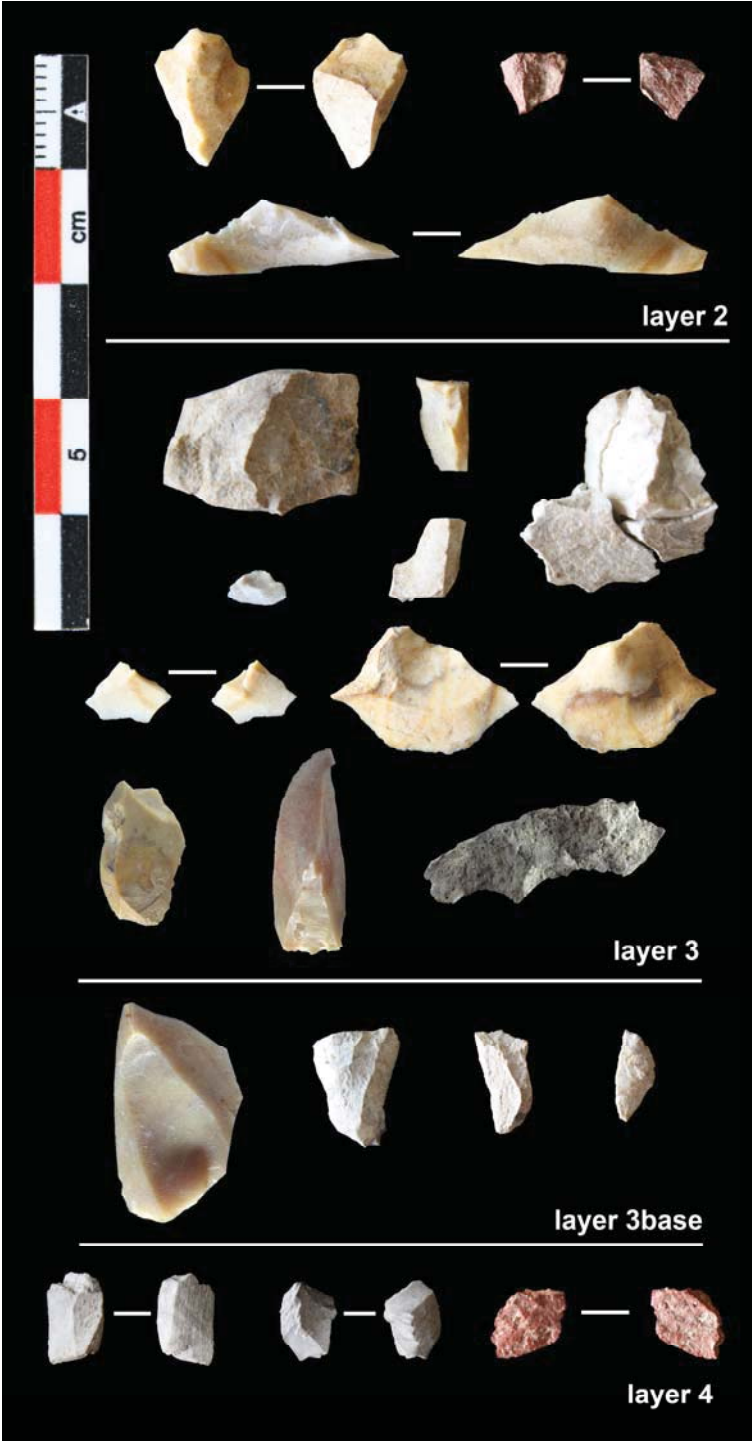


Fig. 05. Examples of flint, jasper and siliceous limestone flakes collected during the new excavations. The stratigraphic unit from which the flakes originate is indicated.

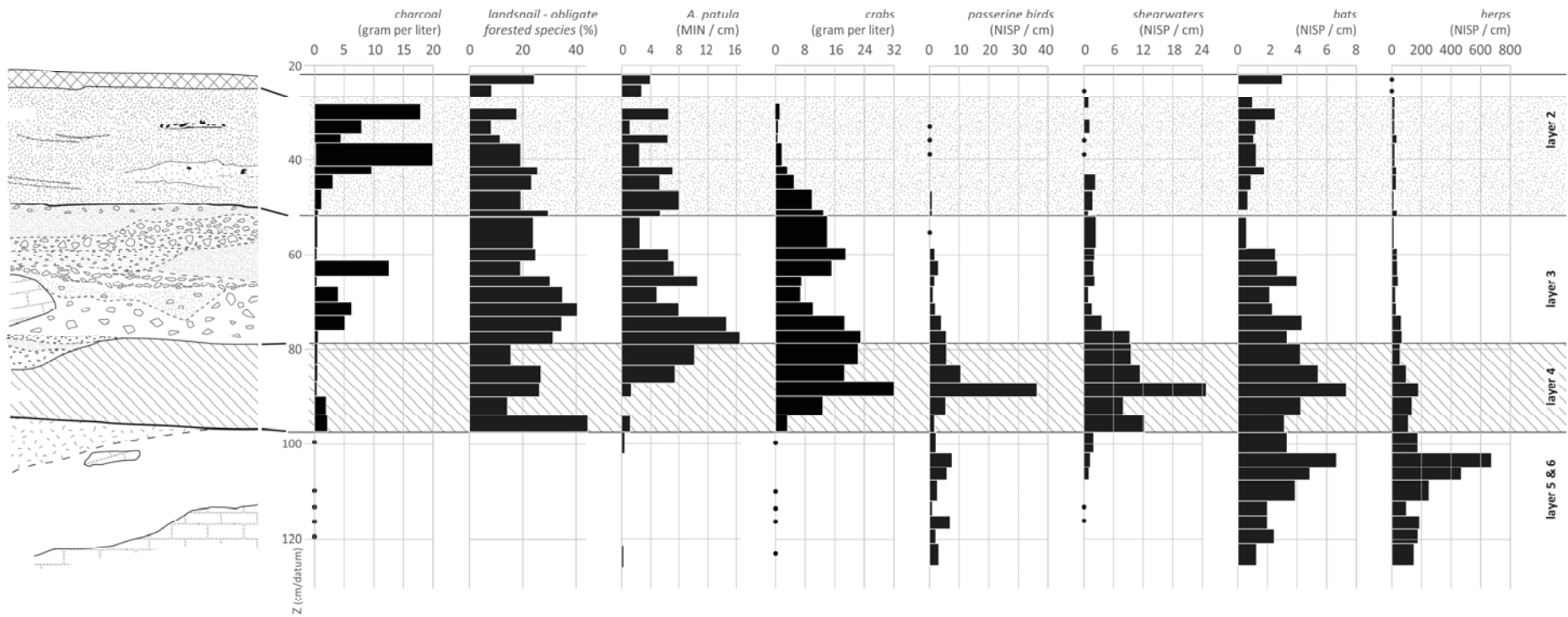


Fig. 06. Stratigraphic distribution of the different archaeological and faunal components considered in the discussion of the presence of an Archaic occupation of the Abri Cadet 3. The quantities reported were measured in the stratigraphic column (exhaustive sorting, sub-square F3c). The dots represent quantities too small to be represented by bars.

The presence of combustion features combined with flaked-stone artefacts from the base of the median member securely place the first episodes of human occupation of the site around the third millennium BCE, i.e. in the first stage of the Archaic Age. However, the remains of these occupations are not very prominent: the anthropogenic elements form only a small fraction of the otherwise natural sediment. The small size of the features and the partial preservation of the structures, such as the lenses of charcoal and ash preserved in the rear part of the shelter only, is likely to make this type of occupation hard to identify.

### 3.4 Palaeoenvironment

The snail shells recovered during the excavation correspond to 11 taxa, i.e. half the number of terrestrial mollusc species currently present on the island (Charles 2015). The taxa identified in the 2004 survey were recovered (*Chondropoma crenulatum*, *Amphibulima patula*, *Pleurodonte josephinae*, *Bulimulus guadalupensis*), supplemented by smaller species (e.g., *Helicina fasciata*, *Lacteoluna selenina*, *Pupoides albilabris*, *Allopeas micra*, *Beckianum beckianum*).

The NMI count of shells collected in the sieve column allows the proportion of strictly forest taxa (*P. josephinae*, *H. fasciata*, *P. albilabris*) to be established. *A. patula*, which is also a forest species, was removed from the counts for the calculation of this rate, since all or part of this taxon is assumed to be the result of a human introduction in the site (see below). The rate of forest snails thus varies between 8 and 40% in the whole sequence (Fig. 06).

Remarkably, the moluscostratigraphy is not superimposed on the lithostratigraphy, indicating that sedimentation patterns do not control this signal. In particular, a forest optimum is evident in the middle member, before decreasing from the middle part of layer 3 to the top of the infilling. Most importantly, a lower proportion of forest species can be seen in the middle part of layer 4. This record suggests thus a recession of the forest at the same time as the site is occupied by Archaic people. Surprising as it may be, this result is consistent with P. Siegel's team's coring implemented in the northern part of the island. This coring reveals a sudden increase in microcharcoal values as early as 3000 BP, which is believed to reflect a preceramic transformation of the island's landscape (Jones *et al.* 2018).

### 3.5 Subsistence of Archaic peoples

Different categories of faunal remains were collected during the excavation for which the question of consumption by Archaic peoples arises. Most of the faunal remains from layers 3 and 4 consist of invertebrate remains, but the assemblage also includes vertebrate remains, mainly those of squamates, followed by birds, bats and, to a lesser extent, fishes.

#### *Terrestrial molluscs*

The 2004 survey and the new excavations revealed a very large quantity of a distinctive terrestrial mollusc, *Amphibulima patula*. The shells of this snail are present in the median member as well as, to a lesser extent, in the upper member of the stratigraphy (Fig. 06). This species is the largest of the snails native to Guadeloupe. It is found in cool and moist places in the dry forest (Lenoble *et al.* 2018b). This species is now extremely rare in Guadeloupe and Marie Galante (Lenoble *et al.* 2018a). The present-day rarity of this species

contrasts with the abundance of shells found in the preceramic levels with several hundred specimens per m<sup>2</sup>.

In addition, many shells are notched, most often in the same position (Fig. 07B). A preliminary count of the material indicates that a quarter to a third of the shells display these notches. *A. patula* is a snail whose soft parts cannot usually retract completely into the shell when active. Therefore, these notches cannot be explained by the action of a predator attempting to access the animal's soft body. These notches rather suggest a pivotal movement of a tool used, for example, to cut the snail's muscle attachment. This is why it is thought that these snails were eaten by humans.

Furthermore, the size of adult individuals (shell length > 3cm) decreases over time between the pre-anthropogenic levels (layers 5 and 6) and the first preceramic level (layer 4), on the one hand, and the more recent levels (layer 3base, layer 3 and layer 2), on the other hand (Fig. 07A). A Mann-Whitney test confirms that the difference in sample size is highly significant (Tab. 03). The reduction in size of this snail occurs between layers 4 and the base of layer 3, i.e. during the preceramic occupation of the site and, more precisely, when the snail is the most abundantly collected by Archaic people (Fig. 06).

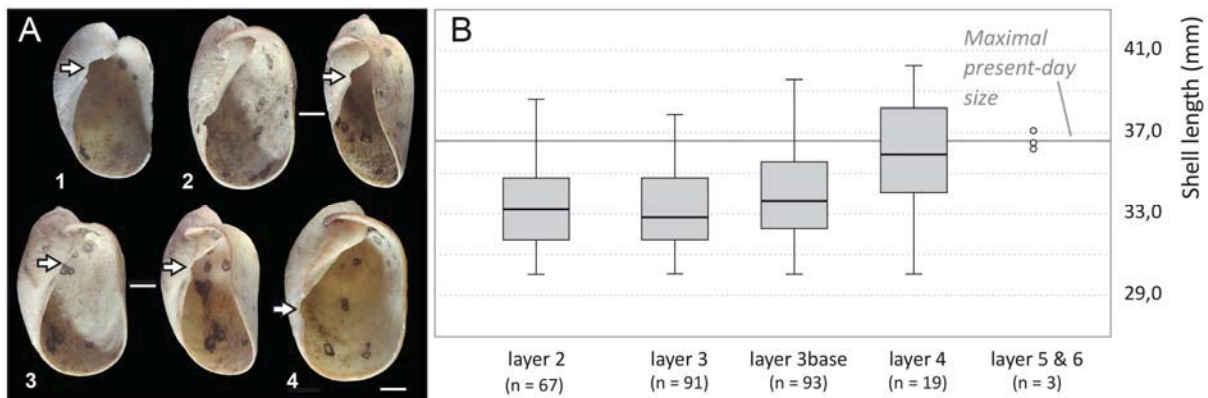


Fig. 07. A – shells of *Amphibulima patula* showing notch (indicated by an arrow). The bar features 5 mm. 1, layer 3base; 2, 3, 4: layer 4. B – boxplot showing the size distribution of *A. patula* adult specimens in the different layers of the Abri Cadet 3.

layers	2	3	3base	4	5&6
2		0,62	0,19	<b>0,0022</b>	<b>0,013</b>
3			<b>0,033</b>	<b>5,09E-04</b>	<b>0,0092</b>
3base				<b>0,0084</b>	<b>0,019</b>
4					0,56
5&6					

Table 3. Probability of the Mann-Whitney test comparing two by two the shell length distribution of adult specimens of *Amphibulima patula* ( $L \geq 30$  mm) in the different layers. Values in bold indicate a probability supporting the hypothesis of a significant difference between samples ( $p < 0.05$ ).

Climatic variations are likely to induce a change in the size of terrestrial mollusc populations, mainly in relation to variations in rainfall (Goodfriend 1992). In the present case, past climatic variations do not explain the observed change in size, as this change is evidenced within a stable climatic phase, the Holocene wet optimum (Curtis *et al.* 2001). It is therefore thought that this variation in size reflects overexploitation of the species or a human-induced degradation of the snail habitat.

### *Land crabs*

Crab remains are almost exclusively represented in the median member, within layer 4 but also in layer 3 where they can form an important part of the stony lenses (Fig. 06). A first examination of the remains indicates that these remains correspond mainly to land crab (Gecarcinidae gen. et sp. indet.) alongside some elements of hermit crab (*Coenobita clypeatus*). In addition, the frequent presence of burning mark on the dactyl or propodus extremities can be observed (Fig. 08). The specific location of these traces is difficult to explain by accidental burning in contact with combustion structures. These traces are better explained by preparation practices of the specimens for consumption (e.g., Narganes Storde 1991). Hence, it is assumed that most if not all crab specimens were consumed by Archaic people.



*Fig. 08. Dactyl extremities of land and hermit crabs exhibiting burning marks (layer 4).*

## Squamates

Bones of squamate and amphibian are abundant, mainly represented by Anolis lizards (89,3%) completed by small frog (*Eleutherodactylus* sp.), others lizard species (*Pholidoscelus*, *Capitellum*, and *Leiocephalus* lizards) and snakes (racers and the extinct Marie Galante *boa*). In line with 2004 test-pit results, no Iguana remains were found.

Based on the bone fragmentation, the proportion of digestion trace and the skeletal representation of lizards, the taphonomic study of squamate and amphibians bone assemblage concludes to a « typical owl pattern » without significant difference between layers (Sayah *et al.* 2023). The burrowing owl, which could have roost in the site (*cf. infra*), might be an accumulator agent for the Cadet 3 herp bone assemblage at least for smaller species that dominates the assemblage. The larger Antillean Barn Owl (*Tyto noeli*) can't be discarded. This bird of prey is considered to be an accumulation agent of Pleistocene level bone assemblages of the near grotte Blanchard (Gala & Lenoble 2015; Stoetzel *et al.* 2016), and most of larger squamate species enter its diet (Stoetzel *et al.* 2016a). With that said, it cannot be ruled out that some of the large specimens from the anthropic layers of Cadet 3 would have been collected by humans (i. e. *Pholidoscelis* lizards). But no size selection nor any trace like bone burning or butchering mark supports this assumption (Sayah *et al.* 2023).

## Birds

The study of over 2000 bird remains shows that Procellariiformes, represented by Audubon's shearwater (*Puffinus lherminieri*; 46% of the NISP), and Passerine birds (48% of the NISP) largely dominate the assemblage. The other birds recognised are columbid birds and the burrowing owl (*Athene cunicularia*). This small, now-extirpated owl, is present in in the three members of the infilling, represented by bone of both juvenile and adult specimens, suggesting that this bird used the cave as a nesting site (Gala *et al.* 2020).

In the lower member, birds they are mainly represented by small passerines (e.g., parulidae) whose bones show digestion traces. It is in the lower part of the median member (layer 4) that bird bones are most numerous (Fig. 06), represented by medium-sized passerines and Audubon's shearwaters. The bones of the latter species do not exhibit any traces of digestion. Shearwaters come ashore to breed; they then form colonies of hundreds of birds where the bones of dead individuals can naturally accumulate. But these nesting sites are also privileged places to catch these birds (Wing 2001). The ratio of juveniles to adults is quite comparable between the two bird categories (Passerines: 11%; shearwaters: 8%). But for shearwaters, such a ratio is too low to be consistent with natural mortality on a breeding site. This is most obvious when this data is compared to the nearby grotte Blanchard 2 where such a breeding site was evidenced. The bones of young specimens then represent half of the accumulation of bird bones (Mallye *et al.* 2018), while the ratio seen at



Abri Cadet 3, with a dominant proportion of adults, is comparable to that of the Archaic Plum Piece site, where these birds are reported to be consumed by humans (Hofman *et al.* 2006).

Taken as a whole, the distribution of shearwater bones restricted to Layer 4, the absence of digestion traces, and the selection of adult specimens indicated by the juvenile/adult ratio suggest that the remains of this species were accumulated by Archaic people. Nevertheless, a more detailed taphonomic analysis would be helpful to support this hypothesis and determine also to what extent the large passerine bones present in this level are also the result of human consumption or not.

### *Mammals*

The mammals contained in the whole sequence are mainly represented by bats (90.2%), supplemented by a little over a hundred rodent bones. The latter are found in equal numbers in layers 1 and 2, with a very small number of bones present in the middle part of layer 3. The species represented are the agouti (*Dasyprocta leporinus*), the rice rat *Antillomys rayi*, known from the islands of Antigua and Guadeloupe (Goeddert *et al.* 2020) and, in layer 1, the black rat (*Rattus rattus*).

In contrast, bat remains are mainly represented in the lower part of the infilling (layers 4 to 6, [Fig. 05](#)). Twelve species are identified ([Tab. 04](#)). More than half of them correspond to species that are now extinct on the island. The latter are almost exclusively present in the lower member, which is expected as they characterise the Pleistocene bat fauna of the island (Stoetzel *et al.* 2016b). Besides these extirpated species, bones of extant species were found, among which nectarivorous (*Monophyllus plethodon*) and frugivorous species (*Brachyphylla cavernarum*, *Ardops nichollsi*). The same frugivorous species dominate among the bat remains collected in the median member. These fruit bats are the ones that are consumed in the present, as they were in the Ceramic age in the Lesser Antilles (Lenoble 2019). Thus, their large representation in layers 3 and 4 raises questions about their possible consumption by pre-Columbian peoples. The Antillean fruit-eating bat (*B. cavernarum*) is, however, a cave-dwelling species that may roost in the site or in surrounding caves (Masson *et al.* 1990); as such, the presence of bones in the Cadet 3 infilling may be accidental. The presence of the tree bat (*A. nichollsi*) is more striking as this species, as its name suggest, roosts exclusively in trees (Jones & Genoways 1973). Therefore, it is thought that the presence in numbers of these fruit bats in layer 4 may reflect an accumulation of a raptor, such as the Lesser Antillean barn owl known to consume these species (Stoetzel *et al.* 2016a), or an accumulation of remains eaten by humans. A taphonomic analysis similar to that carried out on the herpetofaunal bones is necessary to further discuss this theory.

layers	1	2	3	4	5&6
<i>Molossus molossus</i>		1	1	1	
<i>Tadarida brasiliensis</i> †			2		7
<i>Mormoops blainvillii</i> †					2
<i>Mormoops megalophylla</i> †					5
<i>Pteronotus cf. macleayi</i> †					1
<i>Pteronotus parnellii</i> †					15
<i>Natalus major</i> †					1
<i>Natalus stramineus</i>			4	7	17
<i>Brachyphylla cavernarum</i>	2	2	19	27	54
<i>Monophyllus plethodon</i>		2			18
<i>Ardops nichollsi</i>		3	5	21	10
<i>Phyllonycteris poeyi</i> †					2
<b>Total</b>	<b>2</b>	<b>8</b>	<b>31</b>	<b>56</b>	<b>132</b>

Table 4. Number of Identified Skeletal Parts (based on humerus, skull and mandible) of the bat taxa identified in the different stratigraphic layers of subsquares F3c & F3d (2018 excavations). The symbol † indicates extirpated or extinct species.

### Fishes

The results concerning the fish remains recovered at the excavation do not differ from those of the 2004 test-pit. The number of fish bones collected is low (NRD = 252) and the great majority (71%) were collected in layer 2 where they are represented by small pelagic fish (Clupeidae) alongside medium to large reef fish (Scaridae, Lutjanidae, Haemulidae). In contrast, only about twenty fish bones were collected in layers 3 and 4, corresponding mainly to reef fish (Acanthuridae, Holocentridae, Scaridae). With the exception of a parrotfish bone collected in the upper part of layer 3, all are bones of small specimens for which a natural origin cannot be ruled out. The very few fish bones and the possibility of natural introduction of these remains clearly shows that it was not this resource that motivated the occupation of the site by Archaic people.

## 4. Discussion

The excavations of the Abri Cadet 3 provide new data on the pre-Columbian occupation of the site and, more globally, on the island of Marie Galante.

The finding of a burial in the upper part of the stratigraphy confirms the funerary character of the caves in Guadeloupe Islands during the late Ceramic period (Grouard *et al.* 2013; Mendisco *et al.* 2015). With now four funerary caves next to each other, the southern coast of Marie Galante is particularly noteworthy in this respect. In addition, the Cadet 3 burial also illustrates the importance of child burial in funeral practice associated with caves (Partiot *et al.* 2020). Radiometric dating of individuals exhumed in the nearby grotte Cadet 2 and Blanchard places these burials between the 14th and 17th centuries, while Ceramic sherds from these sites suggests an earlier age (Courtaud 2011; Courtaud *et al.* 2014). The Abri Cadet 3 shows that the two records can be asynchronous: a domestic occupation at the Troumassoide and a funerary purpose in the final Ceramic period. This asynchronism is consistent with the interpretation of the Trois Rivières site in Guadeloupe of a reuse of abandoned village as cemetery (van den Bel & Romon 2010).

The new excavations at the Abri Cadet 3 also provide new evidence for the occupation of the site in the Archaic Age. The abundance of crab and terrestrial mollusc remains in the median member was revealed by the 2004 test-pit and this led to the hypothesis of a possible human origin, although it was not possible at that time to differentiate between human or natural origin of the accumulation (Stouvenot *et al.* 2013). The presence of both flint flakes and combustion features at the base of the median member (layer 4) attests to the frequentation of this site by humans in the Archaic age. Moreover, there is no flint deposit on Marie Galante, which makes all the more demonstrative the human origin of the flakes collected during the excavation.

The dates obtained in the course of the new excavations make possible to chronologically locate the onset of this Archaic occupation. These dates indicate that the lower part of the median member (layer 4) was formed at the very beginning of the third millennium before the common era. This age is that of a burial in the Morne Rita cave on the same island (Fouéré *et al.* 201), and that of the occurrence of significant amounts of microcharcoal in a core sample from the North of the island (Jones *et al.* 2018). The onset of the occupation of Cadet 3 thus appears to occur at the very beginning of the preceramic occupation of the island.

The very early occupation of the site is shown by comparison with the dates of the earliest Archaic occupations of the Lesser Antilles. The age of the Archaic levels of the Abri

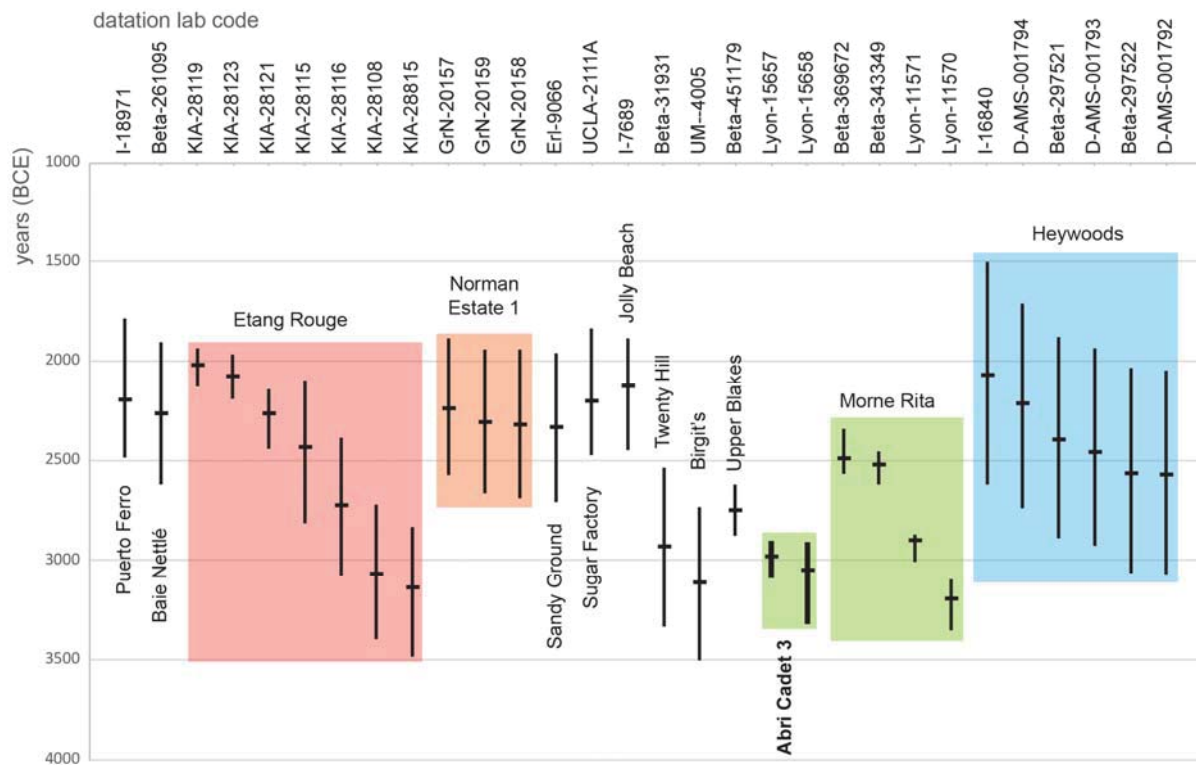


Fig. 09. Calibrated age ranges (cal BCE) of Lesser Antillean Archaic sites with a median probability older than 2 kyr BCE. The confidence interval corresponds to 2 sigmas. The datations reported in this graph come from Goodwin 1978; Davis 1982; Nokkert et al. 1995; de Mille 2011; Fitzpatrick 2011; Fouéré et al. 2013; Bonnissent et al. 2016; Cherry et al. 2019; Napolitano et al. 2019. Two datations of the Morne Rita Cave (Lyon-11571[SacA39232]) and (Lyon-11570[SacA39231]) were orally communicated by P. Fouéré. Except for the Antiguan sites of Birgit's and Twenty Hill, for which the marine sample stay unidentified, all these datations are consistent with the chronometric hygiene approach of Napolitano et al. (2019), even some datations discarded by these authors were taken into account when missing information (context, material) was found in the literature. Calibration was done using CALIB 8.2 (Stuiver & Reimer 1993). The intcal 20 curve was used for terrestrial material (charcoal or organic tissue). The marine20 curve was used for marine shells, corrected with a mean  $dR$  value of  $-146 \pm 114$  yr (DiNapoli et al. 2021), except for the Heywoods site where the local  $dR$  value of  $-165 \pm 182$  was applied.

Cadet 3 is indistinguishable from the oldest human occupations in this region (Fig. 09). This site therefore provides further evidence for initial human settlement of the Lesser Antilles as early as 3.2 - 3 kyr BCE. Moreover, these results are consistent with the hypothesis that this settlement may have been rapid (chronologically indistinguishable) on all the islands of the Lesser Antilles.

The amount of time for which the site has been occupied or reoccupied is more difficult to assess. The sedimentary analysis shows that the base of the intermediate member (layer 4) is formed of a palaeosol reflecting a phase of landscape stability. By contrast, the upper part of this same member (layer 3) is formed by a pile of debris flow deposits in relation with the expansion of a colluvial fan in the shelter. Not only are these sedimentation episodes likely to be discrete, linked to a few major morphogenic events, but

the sorting of the archaeological component contained in the stony lenses suggests that all or part of the material may have been redistributed into the shelter by debris flows. For these reasons, it is quite possible that the material found in the lenses of layer 3 represents an accumulation of several occupations, without it being possible to determine the recurrence and importance of the different occupations. The age obtained from the middle part of layer 3 (Erl-10156) suggests, however, that the Archaic presence in the shelter continued at least until the second millennium BCE. Further dating of remains thought to be directly related to human occupation of the shelter, such as the land crab remains, would be useful to clarify this point.

Apart from the faunal remains, the evidence for the Archaic occupation of the Abri Cadet site is discrete: a limited number of flint flakes and small combustion structures. The flint flakes recovered are, moreover, very small elements, which are thought to be related to a tool maintenance function. This may explain why this type of occupation has so far failed to be investigated by conventional archaeology. As already illustrated by the re-excavation of Buccament Valley rockshelter on St Vincent (Hackenberger 1991), the identification of such occupations requires the use of specific techniques, namely a fine-mesh water sieving combined with precise stratigraphic positioning of the samples.

The Archaic occupations of the Lesser Antilles are most often expressed by accumulations of shells which give them their archaeological visibility (e.g., Goodwin 1978; Davis 2000; Bonnissent *et al.* 2016). However, inland sites have been documented (Cherry *et al.* 2012; Hofman *et al.* 2006; Stouvenot & Casagrande 2015), which indicate that these peoples were not limited to the exploitation of marine resources. The Abri Cadet 3 is a further example of the non-dependence of Archaic peoples on marine resources. This site is particularly demonstrative since the shelter is located in a coastal context. The rockshelter is close to the present shoreline, and consideration of sea level rise and isobaths indicates that this shoreline was only a few hundred metres further away during the Archaic occupation of the site. It is therefore not the distance to the sea that can explain the absence of a marine component among the subsistence remains, but rather an inland-oriented subsistence of Archaic people that sheltered into the site.

Yet, even in comparison with the Archaic inland sites, Cadet Shelter 3 stands out because of the very small number of artefacts collected. This can be explained by the absence of siliceous lithic resources on the island of Marie Galante, whereas the sites of Upper Blake's in Montserrat (Cherry *et al.* 2012) and the heights of Capesterre in Guadeloupe (Stouvenot & Casagrande 2015) would both correspond to lithic procurement sites. Nevertheless, no mortars or pestles were found either, nor were any shell adzes or preforms, although such pieces are not uncommon in Archaic inland sites (e.g., Hofman *et al.*

2006). This scanty toolkit may suggest that the occupations of the Cadet 3 shelter, although they may have been repeated, were each of short duration.

Actually, the remarkable nature of the Cadet 3 shelter is its rich content of vertebrate fauna and, above all, invertebrate fauna testifying to subsistence activities. Documenting this subsistence is, however, not straightforward, insofar as the remains accumulated at the site combine a naturally accumulated component with a component of animals consumed by humans. The natural origin of the assemblage is evident for the layers of the lower set, i.e. prior to the human occupation of the site. But the question of the origin of the accumulation also arises for the elements contained in the Archaic levels. This is shown by the taphonomic study of the squamate remains, which concludes that almost all, if not all, of the bones of this faunal group are of natural origin, as well as by the incipient nature of the rare fish bones found in the median member. Alongside this, other faunal groups have sufficient evidence to indicate or at least strongly suggest that their accumulation is the result of human consumption, such as *Amphibulima patula* with notched shells, crab remains exhibiting frequently burnt dactyl and propodus tips, or shearwater bones represented mainly by adult individuals.

In accordance with the archaeological knowledge of the Caribbean, mammals were apparently not prominent in the diet of Archaic peoples (Cooke *et al.* 2017). Plant visiting bats could have been hunted, as suggested by the higher proportion of tree bats in layer 4. However, this result remains to be ascertained on the basis of a taphonomic analysis of the bat bone assemblage. The absence of rodents in the Archaic levels is, however, quite noteworthy. No rodent species is known from the Pleistocene record of the island (Stoetzel *et al.* 2016b), while agouti and rice rat are commonly found in Ceramic sites on Marie Galante (Grouard 2001; Durocher *et al.* 2021), implying that these mammal species were introduced by the pre-Columbian peoples. The stratigraphy of the Abri Cadet 3 indicates the age at which these introductions took place. Rodent remains only appear in the upper part of layer 3, which is contemporary to the Ceramic age. Such an age for the introduction of the agouti to Marie Galante is in line with the knowledge of South American species introduced to the Lesser Antilles in the early Ceramic period. (Wing 2001; Wing 2008). The introduction of the rice rat to Marie Galante is more remarkable as it is a translocation from island to island that is not commonly evidenced. In any case, the introduction of species from the nearby continent or the translocation of Lesser Antillean species appears to be a behaviour characteristic of Ceramic peoples, in contrast to Archaic populations for which the exploitation of the terrestrial environment seems to have been limited to taking easily procurable species from the local environment (Keegan 1994).

Archaic peoples of the Lesser Antilles are usually described as highly mobile, collecting locally or seasonally available resources, mainly shallow-water marine resources (Goodwin 1978; Davis 2000; Newson & Wing 2004; Bonnissent *et al.* 2016). The archaeological expression of this way of life is found in camps located close to the exploited resources, occupied briefly and reoccupied for centuries or millennia (Bonnissent *et al.* 2016, Davis 2000). The Abri Cadet 3, like the site of Plum Piece on Saba, nevertheless illustrates that some sites were dedicated to a forest-oriented subsistence.

The theory of seasonal occupation has been put forward for the Plum Piece site where land crabs and shearwaters are the main animal resources exploited. Insofar as these same resources are exploited at the Cadet 3 site, along with land snails, the question arises of a similar seasonal occupation. The shearwater is an oceanic bird that only comes ashore during the breeding season, from January to June in the Lesser Antilles (Precheur 2015). Crabs are particularly easy to catch during their annual migration to the sea to spawn. However, this migration takes place at different times according to the species. Two crabs are particularly consumed in the Caribbean (Wing 1999): the mountain crab (*Gecarcinus ruricola*) and the blue land crab (*Cardisoma guanhumi*). The first species migrates from May to August (Tedford 2018) and the second during the rainy season from June to December (Gifford 1962). However, the latter species can easily be caught throughout the year by placing traps in front of its burrows, which is the traditional method of capture (Maitland 2002). The mountain crab does not have a burrow and its activity is nocturnal, but it is still quite easy to catch at night with torches after heavy rains that follow a dry spell, as it is still practiced in Dominica (Miculka 2009). Finally, *A. patula* is a snail living in moist places, which retracts entirely into its shell only when it dries out to take shelter during dry spells (Pilsbry 1899). The snail is thus most easily collected during the time of species activity, that means in the wet conditions of the rainy season. Thus, from shearwaters nesting in spring, to snails being active in the rainy season, and crabs that migrate during the first months of the rainy season but can also be trapped during the rest of the year, no straightforward relation emerges between the ecology of preyed species and a seasonal occupation of the site.

In addition, variations are apparent in the stratigraphic distribution of faunal remains within the preceramic layers. Shearwaters are mostly represented in layer 4, land crab remains from the middle part of this layer to the base of the overlying layer 3 and *A. patula* shells in the upper part of layer 4 but mainly at the base of layer 3. Taken together, this suggests that the species consumed by humans may have varied between the different occupations of the site, being more consistent with opportunistic occupations than with regular seasonal occupation. In addition, one point remains unexplored, namely the possible overexploitation of animal resources leading to a change in the timing of site occupation in order to exploit a larger set of resources. Such a hypothesis may seem inconsistent with the

usual archaeological view of Archaic people corresponding to a small number of groups highly mobile with only a few individuals each (Hofman *et al.* 2006; Bonnissent *et al.* 2016). Yet, such over-exploitation is suggested by the decrease in size of *A. patula* shells; it is also conceivable for shearwater colonies or for crab populations subjected to recurrent predation pressure. A more detailed analysis of the material collected during the new excavations would be desirable to discuss this theory further.

## 5. Conclusions

The new excavations of the Abri Cadet 3 site provide a wealth of information on the pre-Columbian occupation of Marie-Galante. In addition to providing additional data for depicting funerary practices at the end of the Ceramic period, these excavations provide new evidence on the first settlement of the island and, more broadly, of the Lesser Antilles.

The new excavations thus answer to the question raised at the end of the 2004 test-pit, i.e. a possible occupation of the site in the Archaic period. The latter is now well attested even though a remarkable point is the discreteness of the archaeological elements (lithics, combustion features) related to this occupation.

The datations carried out in the new excavations also reveals a very early archaic occupation, around 3 kyr BCE. These dates place this site among the oldest traces of the preceramic occupation of Marie Galante and, more widely, of the Lesser Antilles.

Finally, the new excavations document a situation of archaic inland-oriented subsistence. This may appear surprising when considering both the coastal location of the site and the fact that the Archaic peoples has been regionally described as focused on the exploitation of coastal marine resources. Land snails, land crabs and shearwaters, however, stand out as animal resources exploited by the preceramic people, while marine resources were not considered. Other terrestrial components may also have participated in the preceramic diet (passerines, bats), but a comprehensive analysis of the osteological material is needed to demonstrate it.

With that said, new questions emerge from this excavation: the range of resources exploited, but also the number of similar sites that may have gone undetected, either because of the low archaeological visibility of such occupations or because of less favourable preservation conditions, or yet, the relationships that may have existed between this type of site and the other manifestations of the island's first colonization (funeral cave, deforestation activities suggested by a significant increase in the amount of micro-charcoal in cores).



## 6. Acknowledgments

This study was conducted as a part of the ECSIT Project, conducted by the CNRS with a financial support from the European PO-FEDER program (grant no. 2016-FED-503), the Guadeloupe Regional Council, the DAC of Guadeloupe (PCR Extinctions), and the CNRS (SEEG ECSIT). The authors are grateful to Christian Stouvenot who communicated the fieldnote of his 2004 test-pit and Pierrick. Fouéré who very kindly gave information and permission to use the unpublished datations of the Archaic burial from the grotte du Morne Rita, Marie Galante.

## 7. References

- Bailon, S., Bochaton, C., & Lenoble, A. 2015, New data on Pleistocene and Holocene herpetofauna of Marie Galante (Blanchard Cave, Guadeloupe Islands, French West Indies): Insular faunal turnover and human impact. *Quaternary Science Review*, 128, 127-137.
- Bertran, P., & Coussot, P. 2004, Coulées de débris. In Bertran P. (Ed.), *Dépôts de pente continentaux, dynamique et faciès* (pp. 132-151). Association française pour l'étude du Quaternaire.
- Bonnissent, D., Serrand, N., Bruxelles, L., Fouéré, P., Grouard, S., Sellier-Ségard, N., & Stouvenot, C. 2016, Archéoécologie des sociétés insulaires des Petites Antilles au Mésoindien. In C. Dupont & G. Marchand (Eds.) *Archéologie des chasseurs-cueilleurs maritimes. De la fonction des habitats à l'organisation de l'espace littoral* (pp. 213-260). Société Préhistorique française.
- Cardoso, H.F.V. 2009, A test of three methods for estimating stature from immature skeletal remains using long bone lengths. *Journal of Forensic Sciences*, 54(1), 13-19.
- Casagrande, F., Grouard, S., Serrand, N., Lenoble, A., & van den Bel, M. 2013, Guadeloupe, Capesterre-de-Marie-Galante, Petite-Anse. Archaeological excavation report. Inrap Grand Sud-Ouest.
- Charles, L. 2015, Mollusques terrestres de l'archipel de la Guadeloupe, Petites Antilles. Rapport d'inventaire. Study report. DEAL Guadeloupe.
- Cherry, J.F., Ryzewski, K., Leppard, T.P., & Bocancea, E. 2012, The Earliest phase of settlement in the Eastern Caribbean: New evidence from Montserrat. *Antiquity*, 86(334), 1-5.
- Cooke, S.B., Davalos, L.M., Mychajliw, A.M., Turvey, S.T, and Upham N.S. 2017, Anthropogenic extinction dominates Holocene declines of West Indian mammals. *Annual Review of Ecology, Evolution, and Systematics*, 48, 301-327.
- Courtaud, P. 2011, La cavité sépulcrale de Cadet 2 (Capesterre-de-Marie-Galante, Guadeloupe) et la question du cannibalisme. *Cahiers d'Histoire de l'Amérique Latine*, 5, 49-58.
- Courtaud, P., Dumontier, P., Lenoble, A., & Serrand, N. 2014, La grotte Blanchard. In Bilan Scientifique 2012 (pp. 79-82). Service Régional de l'Archéologie, DRAC Guadeloupe.
- Curtis, J.H., Brenner, M., and Hodell, D.A. 2001, Climate change in the circum-Caribbean (Late Pleistocene to Present) and implications for regional biogeography. In C.A. Woods & F.E. Sergile (Eds.) *Biogeography of the West Indies: Patterns and Perspectives* (pp. 35-54). CRC Press.
- Davis, D.D. 1982, Archaic Settlement and Resource Exploitation in the Lesser Antilles: Preliminary Information from Antigua. *Caribbean Journal of Science*, 17(1-4), 107-122.
- Davis, D.D. 2000, Jolly Beach and the preceramic occupation of Antigua, West Indies. *Yale University Publications in Anthropology* 84.
- De Mille, C. 2011, New evidence and understanding of the Antiguan Preceramic. In Proceedings of the 23rd IACA, Antigua, pp. 428-446.

- DiNapoli, R.J., Fitzpatrick, S.M., Napolitano, M.F., Rick, T.C., Stone, J.H., & Jew, N.P. 2021, Marine reservoir corrections for the Caribbean demonstrate high intra- and inter-island variability in local reservoir offsets. *Quaternary Geochronology*, 61(101126).  
<https://doi.org/10.1016/j.quageo.2020.101126>.
- Durocher, M., Nicolas, V., Perdikaris, S., Bonnissent, D., Robert, G., Debue, K., Evin, A., & Grouard, S. 2021, Archaeobiogeography of Extinct Rice Rats (*Oryzomyini*) in the Lesser Antilles during the Ceramic Age (500 BCE–1500 CE). *The Holocene*, 31(3), 433-445.
- Fitzpatrick, S.M. 2011, Verification of an Archaic Age Occupation on Barbados, Southern Lesser Antilles. *Radiocarbon*, 53(4), 595-604.
- Fouéré, P., Bailon, S., Bonnissent, D., Chancerel, A., Courtaud, P., Deguilloux, M.-F., Grouard, S., Lenoble, A., Monney, J., Mora, P., Pinçon, K., Queffelec, A., Serrand, N., & Tomadini, N. 2013, La grotte du Morne Rita (commune de Capesterre de Marie-Galante, Guadeloupe). Rapport de sondages archéologiques– relevé d’art pariétal. Service Régional de l’Archéologie, DAC Guadeloupe.
- Gala, M., Laroulandie, V., & Lenoble, A. 2020, Past Distribution of the Burrowing Owl (*Athene Cunicularia*) in the Lesser Antilles: New Evidence from Saint Martin and Guadeloupe (FWI). *The Wilson Bulletin*, 132(4), 868-880.
- Gala, M., & Lenoble, A. 2015, Evidence of the Former Existence of an Endemic Macaw in Guadeloupe, Lesser Antilles. *Journal of Ornithology*, 156(4), 1061-1066.
- Gifford, C.A. 1962, Some Observations on the General Biology of the Land Crab, *Cardisoma Guanumi* (Latreille), in South Florida. *Biological Bulletin*, 123(1), 207-223.
- Goedert, J., Cochard, D., Lorvelec, O., Oberlin, C., Cuzange, M.-T., Royer, A., & Lenoble, A. 2020, Isotopic Ecology and Extirpation Chronology of the Extinct Lesser Antillean Native Rodent *Antillomys Rayi* Brace et al. (2015). *Quaternary Science Reviews*, 245, 106509.  
<https://doi.org/10.1016/j.quascirev.2020.106509>.
- Goodfriend, G.A. 1992, The Use of Land Snail Shells in Paleoenvironmental Reconstruction. *Quaternary Science Reviews*, 11(6), 665-685.
- Goodwin, R.C. 1978, The Lesser Antillean Archaic: New Data from St Kitts. *Journal of the Virgin Islands Archaeological*, 5, 6-16.
- Grouard, S. 2001, Subsistance, systèmes techniques et gestion territoriale en milieu insulaire antillais précolombien - Exploitation des Vertébrés et des Crustacés aux époques Saladoïdes et Troumassoïdes de Guadeloupe (400 av. J.-C. à 1 500 ap. J.-C.). Doctoral thesis, Université Paris X, Nanterre.
- Grouard, S., Bonnissent, D., Courtaud, P., Fouéré, P., Lenoble, A., Richard, G., Romon, T., Serrand, N., & Stouvenot, C. 2013, Fréquentation amérindienne des cavités des Petites Antilles. Proceedings of the 24th IACA, Martinique, pp. 277-295.
- Hackenberger, S. 1991, Archaeological test excavation of Buccament Valley Rockshelter, St. Vincent: preceramic stone tools in the Windward Islands, and the early peopling of the Eastern Caribbean. Proceedings of the 13th IACA, Curaçao, pp. 86-91.
- Hofman, C.L., Bright, A.J., & Hoogland, M.L.P. 2006, Archipelagic Resource Procurement and Mobility in the Northern Lesser Antilles: The View from a 3000-year-old Tropical Forest Campsite on Saba. *The Journal of Island and Coastal Archaeology*, 1(2), 145-164.
- Jones, J.G., Dunning, N.P., Pearsall, D.M., & Siegel, P.E. 2018, Marie Galante. In P. Siegel (Ed.) *Island Historical Ecology, Socionatural landscapes of the Eastern and Southern Caribbean* (pp. 226-238). Berghahn.
- Jones, Jr J.K., and Genoways, H.H. 1973, *Ardops nichollsi*. *Mammalian Species* 24, 1-2.
- Keegan, W.F. 1994, West Indian Archaeology. 1. Overview and Foragers. *Journal of Archaeological Research*, 2(3), 255-284.
- Lenoble, A. 2014, Opération de sondage du fossé de Petite Anse, commune de Capesterre-de-Marie-Galante. In *Bilan Scientifique 2011* (pp. 37-38). Service Régional de l’Archéologie, DRAC Guadeloupe.

- Lenoble, A. 2019, The Past Occurrence of the Guadeloupe Big-Eyed Bat *Chiroderma Improvisum* Baker and Genoways, 1976 on Marie Galante (French West Indies) with Comments on Bat Remains from Pre-Columbian Sites in the Eastern Caribbean. *Acta Chiropterologica*, 21(2), 299-308.
- Lenoble, A., Bertrand, A., & Charles, L. 2018a. Redécouverte d'*Amphibulima patula* (Bruguière, 1789) à Marie-Galante, Petites Antilles (Gastropoda, Amphibulimidae). *Folia conchylologica*, 46, 31-35.
- Lenoble, A., Bertrand, A., Charles, L., Mallye, J.-B., & Serrand, N. 2018b, Quaternary Occurrence of the Rare Land Snail *Amphibulima patula* (Bruguière, 1789) in Guadeloupe (Mollusca; Amphibulimidae): Ecological and Palaeoenvironmental Implications. *Quaternaire*, 29(2), 121-130.
- Maitland, D. 2002, Convergent design of Caribbean and Philippine bamboo land-crab traps. *Journal of Crustacean Biology*, 22(2), 497-501.
- Mallye, J.-B., Bailon, S., Bochaton, C., Gala, M., Serrand, N., & Lenoble, A. 2018, Blanchard Cave 2: A Historic Period Audubon's Shearwater (*Puffinus Lherminieri*) Nesting Site in Marie-Galante (Guadeloupe Islands, FWI). *Journal of Archaeological Science, Reports*, 17, 250-262.
- Masson, D., Breuil, M., & Breuil, A. 1990, Premier inventaire des chauves-souris de l'île de Marie-Galante (Antilles françaises). *Mammalia*, 54(4), 656-658.
- Mendisco, F., Pemonge, M.-H., Leblay, E., Romon, T., Richard, G., Courtaud, P., & Deguilloux, M.-F. 2015, Where are the Caribs? Ancient DNA from ceramic period human remains in the Lesser Antilles. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 370 (1660). <https://doi.org/10.1098/rstb.2013.0388>.
- Miculka, B.C. 2009, Burrowing habits, habitat selections, and behaviors of four common Dominican land crabs; *Guinotia dentata*, *Gecarcinus lateralis*, *Gecarcinus ruricola*, and *Cardisoma guanhumi*. Study report. *Dominica Tropical Research Biology*.
- Moorrees, C.F.A., Fanning, E.A., & Hunt, E.E. 1963, Formation and Resorption of Three Deciduous Teeth in Children. *American Journal of Physical Anthropology*, 1(2), 205-213.
- Napolitano, M.F., DiNapoli, R.J., Stone, J.H., Levin, M.J., Jew, N.P., Lane, B.G., O'Connor, J.T., & Fitzpatrick, S.M. 2019, Reevaluating Human Colonization of the Caribbean Using Chronometric Hygiene and Bayesian Modeling. *Science Advances* 5(12), eaar7806. <https://doi.org/10.1126/sciadv.aar7806>.
- Narganes Storde, Y. M., 1991, Los restos faunísticos del sitio de Puerto Ferro Viesques, Puerto Rico. *Proceedings of the 14th IACA, Barbados*, pp. 94-114.
- Newsom, L.A., & Wing, E.S. 2004, *On Land and Sea: Native American Uses of Biological Resources in the West Indies*. University of Alabama Press.
- Nokkert, M., Brokke, A., Knippenberg, S., & Hamburg, T. 1999, An Archaic Occupation at Norman Estate, St. Martin. *Proceeding of the 16th IACA, Guadeloupe*, pp. 333-361.
- Partiot, C., Courtaud, P., Lenoble, A., & Cochard, D. 2020, La question de l'utilisation sépulcrale des cavités naturelles par les populations amérindiennes des Petites Antilles : apports de l'étude archéanthropologique du site de la grotte des Bambous (Guadeloupe). *Bulletin de la Société d'Anthropologie de Paris*, 32, 1-12.
- Pestle, W.J., & Laffoon, J.E. 2018, Quantitative Paleodietary Reconstruction with Complex Foodwebs: An Isotopic Case Study from the Caribbean. *Journal of Archaeological Science: Reports*, 17, 393-403.
- Pilsbry, H.A. 1899, *Manual of Conchology, Structural and Systematic. Second Series: Pulmonata, Vol. 12 - American Bulimulidae : North American and Antillean Drymaeus, Meiostracus, Orthalicinae and Amphibuliminae*. Academy of Natural Sciences of Philadelphia.
- Precheur, C. 2015, *Ecologie et conservation du puffin d'Audubon (Puffinus Lherminieri Lherminieri) de la Réserve Naturelle des Ilets de Sainte-Anne (Martinique)*. Doctoral Thesis, Université des Antilles.
- Reimer, P.J., Austin, W.E., Bard, E., Bayliss, A., Blackwell, P.G., Ramsey, C.B., Butzin, M., Cheng, H., Edwards, R.L., Friedrich, M., Grootes, P.M., Guilderson, T.P., Hajdas, I., Heaton, T.J., Hogg, A.G., Hughen, K.A., Kromer, B., Manning, S.W., Muscheler, R., Palmer, J.G., Pearson, C., van der Plicht, J., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Turney, C.S.M., Wacker, L., Adolphi, F.,

- Büntgen, U., Capano, M., Fahrni, S.M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., & Talamo, S. 2020, The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon*, 62(4), 725-757.
- Royer, A., Malaizé, B., Lécuyer, C., Queffelec, A., Charlier, K., Caley T., & Lenoble, A. 2017, A high-resolution temporal record of vegetation changes in the Eastern Caribbean (Guadeloupe) from 40 to 10 ka BP. *Quaternary Sciences Review*, 155, 198-202.
- Sayah, M., Lenoble, A., & Bochaton, C. 2023, Taphonomic analysis of a Caribbean subfossil herpetofaunal bone assemblage (Marie Galante Island, Lesser Antilles). *Comptes Rendus Palévol.* 22(24), 497-510.
- Stoetzel, E., Fraysse, A., Grouard, S., Bochaton, C., Gala, M., Lenoble, A., & Denys, C. 2016a. Diet of the Lesser Antillean barn owl *Tyto insularis* (Aves: Strigiformes) from Dominica (Lesser Antilles). *Caribbean Journal of Science*, 49(1), 91-100.
- Stoetzel, E., Royer, A., Cochard, D., & Lenoble, A. 2016b, Late Quaternary changes in Bat palaeobiodiversity and palaeobiogeography under climatic and anthropogenic pressure: new insights from Marie Galante, Lesser Antilles. *Quaternary Science Review*, 143, 150-174.
- Stouvenot, C., & Casagrande, F. 2015, Recherche des occupations précolombiennes dans les hauteurs de Capesterre-Belle-Eau (Guadeloupe) : résultats préliminaires. Paper presented at the 26th IACA, Sint-Maarten.
- Stouvenot, C., Grouard, S., Bonnissent, D., Lenoble, A., Serrrand, N., Sierpe, V., & Baillon, S. 2013, L'abri sous roche Cadet 3 (Marie-Galante) : un gisement à accumulation de restes de faune et vestiges archéologiques précolombiens. *Proceedings of the 24th IACA, Martinique*, pp. 126-140.
- Stouvenot, C., Beauchêne, J., Bonnissent, D., & Oberlin, C. 2015, Datations radiocarbones et le «problème vieux bois» dans l'arc antillais: état de la question. In *Proceeding of the 25th IACA, Puerto Rico*, pp. 459-494.
- Stuiver, M., & Reimer, P.J. 1993, Extended 14C Data Base and Revised CALIB 3.0 14C Age Calibration Program. *Radiocarbon*, 35(1), 215-230.
- Tedford, K.N. 2018, Population Structure and Reproductive Migration of Land Crabs on Grand Cayman Island. Master thesis, University of Central Oklahoma.
- van den Bel, M., & Romon, T. 2010, A Troumassoid Site at Trois-Rivières, Guadeloupe FWI. Funerary Practices and House Patterns at La Pointe de Grande Anse. *Journal of Caribbean Archaeology*, 9, 1-17.
- Wing, E.S. 1999, Land Crab Remains in Caribbean Sites. *Proceeding of the 16th IACA, Guadeloupe*, pp. 105-112.
- Wing, E.S. 2001, Native American Use of Animals in the Caribbean. In C.A. Woods & F.E. Sergile (Eds.) *Biogeography of the West Indies: Patterns and Perspectives* (pp. 481-518). CRC Press.
- Wing, E.S. 2008, Pets and Camp Followers in the West Indies. In E.J. Reitz, S.J. Scudder, & C.M. Scarry (Eds.) *Case Studies in Environmental Archaeology* (pp. 405-425). Springer.