



Photo by ICArEHB.

## Earthwatch 2018 Annual Field Report

# DISCOVERING ANCIENT SOCIETIES IN PORTUGAL

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**PERIOD COVERED BY THIS REPORT:** August - September 2018

**DISCLAIMER/AUTHORS' NOTE:** The information presented in this report has not been peer reviewed; and some of the information presented is based on preliminary analysis. The facts may change upon comprehensive analysis of the data.

Dear Earthwatch Volunteers,

The “Discovering Ancient Societies in Portugal” project PIs and staff send you warm greetings. We would like to thank you for supporting us, and for being part of our first ever Earthwatch expedition. We sincerely hope that the time you dedicated to the project and your stay in Muge has been pleasant and has met, or even surpass, your expectations. For us, it was a wonderful summer and we definitely learned a lot from you, not only regarding project management but also on a personal level.

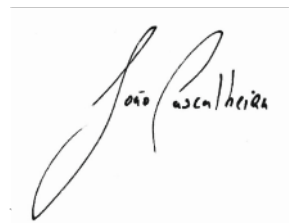
This year’s field season went exceedingly well! We have successfully accomplished all the proposed tasks and goals. With your support, we are going to be able to contribute towards a better understanding of the transition from Mesolithic hunter-gatherers to Neolithic farmers in the Muge region, and to increase our understanding of the complex changes occurred across this important moment of the human past.

All data that you collected during the field work are now being analyzed by the different experts and we expect to publish as soon as possible. Part of the results will be presented during the month of April at the 84th Annual Meeting Society for American Archeology in Albuquerque, NM, USA.

For those who want to receive updates, from January 2019 you can follow our project through the Facebook: <https://www.facebook.com/muge.earthwatch> or Twitter and Instagram: @muge\_earthwatch.

Thank you all for making this a fantastic first year and we hope to see many of you in the future. Your participation is a very important contribution towards this project.

Sincerely,



Gonçalves, Lino André and Nuno Bicho

## SUMMARY

The first Earthwatch expedition in Muge focused on the Mesolithic shell mound of Cabeço da Amoreira (Figure 1), particularly by continuing excavation of an area where shell deposits are expected to be thicker and from where previously obtained radiocarbon dates attested human occupation from c. 8000 until 7400 years ago. One of the most interesting aspects of this year's excavation was the identification of a fairly large, organic-rich but shell-free deposit, in direct contact with the shell midden layers, near the southeast limit of the mound. This unit and its contents (which include large amounts of flintknapping residues and stone tools, as well as a good number of well-preserved animal bones) are very important to better understand the Cabeço da Amoreira mound and the lifeways of the last hunter-gatherer communities in Central Portugal. Mostly because they confirm the co-occurrence of different activity areas (other than just shell processing and consumption) across the site. Additionally, and directly associated with this new layer, several other smaller occupational horizons were detected, revealing that a very complex set of human actions occurred in the past. These included, for example, the possible transport and deposition of sterile sands to create surfaces and to serve as infilling of storage pits.

We believe that these data on the complexity of site formation processes and human actions at Cabeço da Amoreira, somehow mirror the social and behavioural complexity of Mesolithic communities in Muge. Naturally, only after detailed laboratorial analysis of the thousands of samples collected by Earthwatch citizen scientists we will be able to have a better picture on this topic and how it influenced the regional transition to farming.

For the rest of the year we have planned to complete the analysis of the different categories of artefacts (shells, bones, stone tools, etc.), to obtain sedimentological and geochemical data of the excavated sediments, and to radiocarbon date most of the new horizons identified.

## GOALS, OBJECTIVES, AND RESULTS

The Mesolithic-Neolithic transition remains one of the most controversial issues in prehistory archaeology and has attracted, and will continue to attract, significant archaeological debate and extensive research. The main reason is that this was a period of crucial changes in human relationships with the natural world, marking the end of the last hunter-gatherers and the appearance of the first food producing societies in Western Europe. Our knowledge of both periods remain limited, as does our understanding of the transition between them - whether this is entirely cultural in nature or involves the arrival of new Neolithic populations and the demise of the indigenous Mesolithic hunter-gatherers.

The case of Central Portugal, and more specifically of the Tagus valley, with the Muge shellmiddens complex (Figure 1), is currently one of the most important regions to study this transitional phase and certainly help move debate forward. On the one hand, because there is an overlap of a few hundred years in the region between the Muge Mesolithic and the exogenous early Neolithic populations, and on the other, because previous work carried

out in the Mesolithic shellmiddens of Muge revealed preliminary evidence of cultural and genetic interaction between both populations. This last point contradicts the prevailing traditional perspectives on a full human population replacement during the transition. If confirmed the interaction between these two very different adaptation systems is of great importance for our understanding of human eco- and cultural dynamics at the beginning of the Holocene and how these have shaped our own evolutionary path.

Due to its complexity, diversity of artifact assemblages, excellent faunal and human bone preservation, evidence for multiple site function, the Muge shellmiddens represent an ideal opportunity to study the Mesolithic complex hunter-gatherers and their probable integration in the newly arrived exogenous Neolithic societies coming from the Mediterranean sea, and at the same time trying to understand the impact of these food producing societies on the natural environment, regional ecology and cultural background.

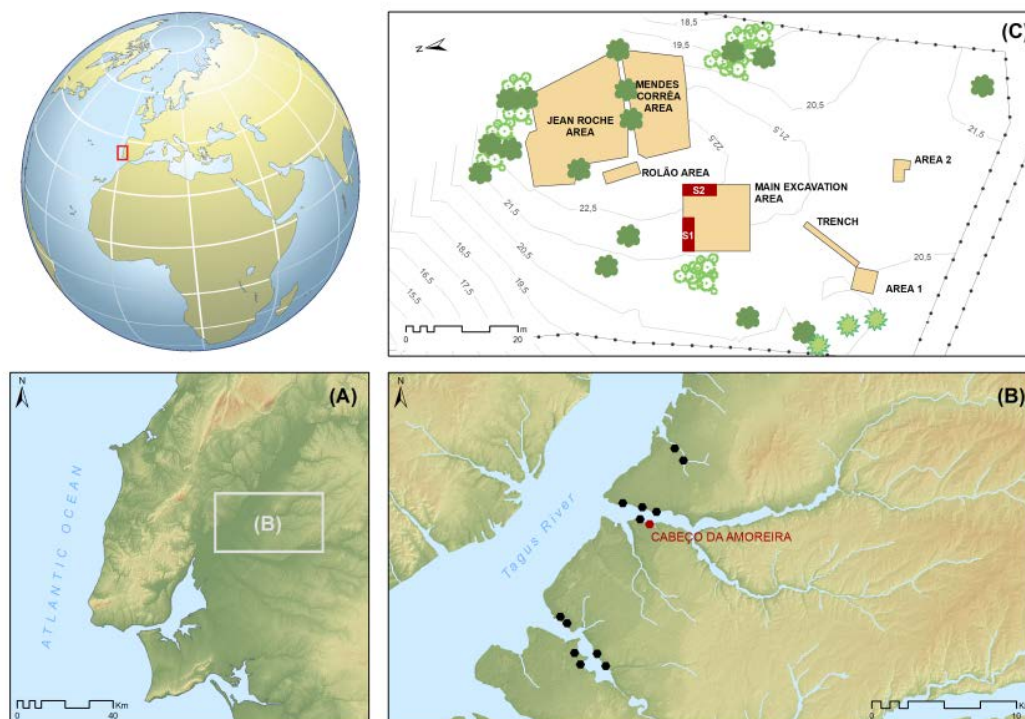


Figure 1 - Location of the Muge Mesolithic complex (A) and shellmiddens in the Muge region (B). Topographic map of the archaeological site of Cabeço da Amoreira with the location of the excavated area in 2018 - S2 (C). Map by Célia Gonçalves *in* Gonçalves *et al.*, 2018.

Our Earthwatch project has four overall objectives: (1) identified cultural and physical alterations in the local mesolithic population, based on DNA and diet, and how are these possibly related population movement and integration; (2) study if there was a differential use among Mesolithic and Neolithic populations (e.g., burial contexts, funerary rituals, prestige items and land use); (3) identify what were the changes and/or continuities in technology; (4) analyze how did the apparent changes in subsistence strategies impacted social changes and the regional ecology.

The 2018 was the first Earthwatch expedition in Muge and was supported by 25 citizen scientists that worked hard across the 6-week field campaign, performing a great diversity of tasks, including excavation, sieving, artifact washing, sorting, and labeling, sediment flotation, among others.

As a result of their effort we were able to excavate more than 3370 liters of sediment, collect more than 9,000 artifacts, and piece plot with a total station more than 10,000 points. Since this was our first year of project most of the results presented below are preliminary, lacking data from the several kinds of laboratorial analysis that are currently undergoing or planned for the beginning of 2019. The objective is to have all data from 2018 processed and analyzed before we start the second field season in August 2019.

This year's excavation focused on a very specific area of the Cabeço da Amoreira shellmound, identified in Figure 1 - B as S2. The main reason behind our choice was the great potential revealed by previous intervention in this area, due to the presence of very rich shell layers and easily identifiable anthropic features, such as spatially circumscribed concentrations of faunal remains (representing episodes of animal's carcass processing and consumption) or negative structures (*i.e.*, pits) cutting into the shell layers. A better understanding of all these features is very important to meet the project's goals, since they represent unique events of the daily lives of the Muge Mesolithic communities, providing us, through the analysis of their nature and composition, with the capacity to specifically answer to some of the goals addressed above.

A total of 8 stratigraphic levels (not counting with within variations represented by a letter as a suffix) were excavated. As expected, a very significant difference among all levels was detected. These differences are related not only with the sedimentary composition of each horizon but also with their archaeological content. Figure 2 represents the counts of artifact types for each stratigraphic level. Counts are normalized by cubic meter of excavated sediment to allow a fair comparison between levels. Although these are preliminary data, we can already attest, for example, the very little diversity in archaeological materials present at levels 14, 16 and 17, in counterpoint with, for example, levels 9 and 10, which reveal very diverse archaeological assemblages, predicting that a broader range of activities occurred during the deposition of these levels.

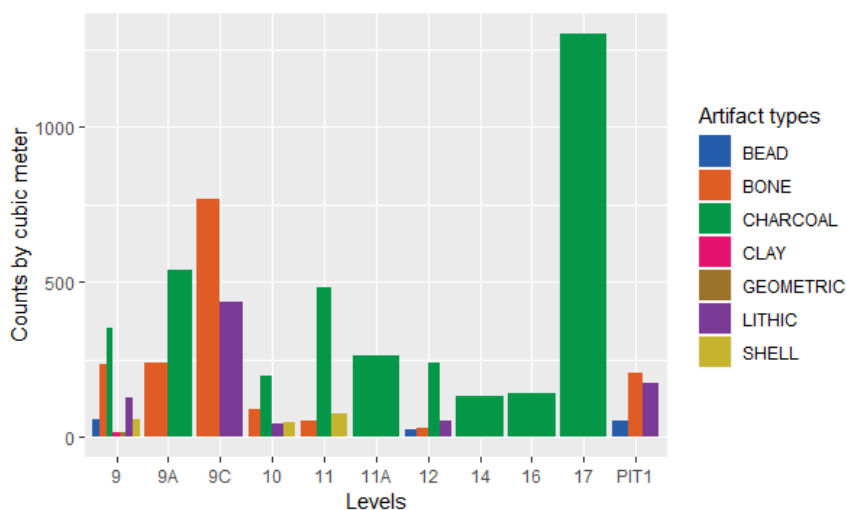


Figure 2 - Counts of artifacts by level.



Among the several types of artifacts recovered we would like to highlight: (1) two very well preserved fragments of red deer antler (Figure 3), that according to our expert in bone/antler technology present evidence of being purposefully broken to obtain a specific section of the antler; (2) one of the largest numbers (n =138) and diversity of perforated shells recovered from Cabeço da Amoreira in a single year from a small excavation area, mostly coming from levels 9, 12 and PIT1 (Figure 4); (3) a small but very interesting collection of geometric microliths (potentially used as projectiles points) that include not only the typical triangles (very common at Cabeço da Amoreira) but also a reasonable number of lunates, which are thought to be not so common at this site (Figure 5); (4) finally, as clear evidence of the good preservation of most of the levels at Cabeço da Amoreira, the set of four fish vertebrae presented in Figure 6 (left) that were found just like it is shown in the photo, which was only possible due to the very patient work of one of the volunteers that spent a long time in clearing that area so we could get the photos and all 3D data with the Total Station.



Figure 3 - Red deer antler fragments. Photo by ICArEHB.

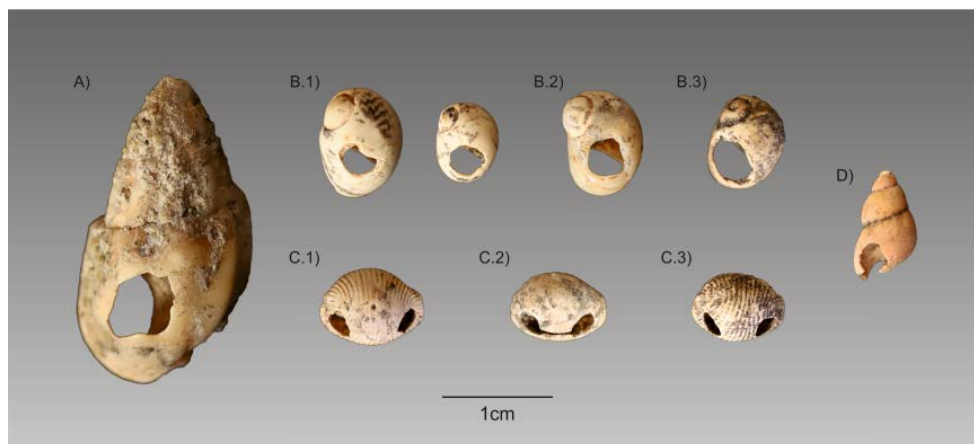


Figure 4 - Beads. A - *Tritia reticulata*; B - *Theodoxus fluviatilis*; C - *Trivia* sp. D - *Bithynia tentaculata*. Photo by ICArEHB.



Figure 5 - Left: A) small blades in chert; B) cores of chert and quartz. Right: geometric microliths. Photo by ICArEHB.

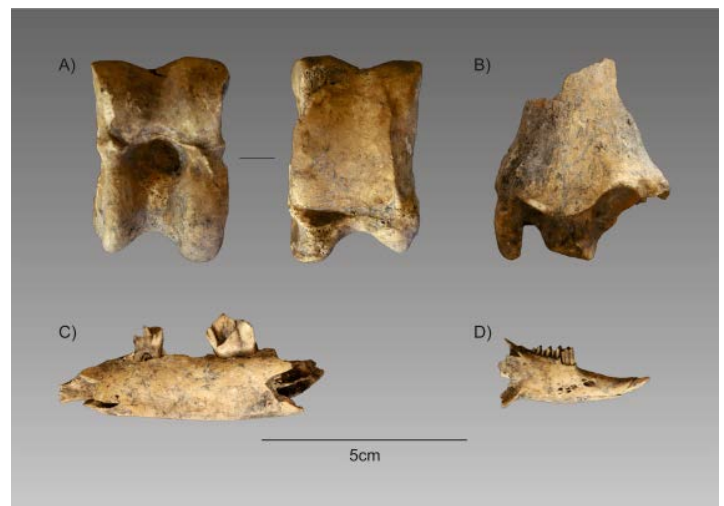


Figure 6 - Left: Detail of fish vertebrae concentration. Right: Faunal remains. A -*Cervus elaphus* astragalus; B -*Cervus elaphus* distal epiphysis; C -*Capreolus capreolus* mandible fragment; D -*Oryctolagus cuniculus* mandible fragment. Photo by ICArEHB.

Regarding stratigraphy, we also confirmed this year that in some cases, such as levels PIT1 and 16, sediments represent past digging anthropic actions that cut through older occupation horizons, causing substantial transformations and remobilization of sediments at the site (Figure 7). The significance of these negative features is still an open question and perhaps one of the most interesting to explore for the upcoming expeditions. Further laboratorial analysis of this year's assemblages, for the identification of, for example, animal species and anatomical representation, or lithic tools classes, will provide a better understanding of the functional nature of those levels. Also, bringing these data together with the results from radiocarbon dating and sedimentary analysis (on course) will inform us on what was exactly happening at the site during the last Mesolithic occupations in the region.



Figure 7 - Negative feature. Photo by ICArEHB.

In fact, to complement our data from field and laboratorial artifact analysis, we also collected this year a series of sediment samples, representing as much as possible all the observed stratigraphic variability. Two types of samples were collected: bulk samples from independent levels, and plaster consolidated samples from relevant spots across the excavation area (Figure 8), in which direct relationship of two or more stratigraphic units could be observed. The first type of samples will be analyzed in the geology laboratories at University of Algarve to collect data regarding grain size distribution and chemical composition of the sediments. The second type of samples will be impregnated with resin and then cut and polished into a thin section that can be observed under the microscope to identify features not visible to the naked eye, such as rapid episodes of erosion or post-depositional disturbances within each stratigraphic level. Naturally, this kind of analysis take time to process and we hope to have all results ready before starting the 2019 expedition. The outcomes of these investigations are very important for us to make better choices of how and what areas and layers to excavate.

Finally, another topic that came to our attention during the field season was the presence of several fragments (mostly from levels 9, 12 and 14) of consolidated clay in which very distinct plant stems imprints could be recognized (Figure 9). This type of occurrence is common in Neolithic and Chalcolithic sites, and most of the times represents evidence of the use of the so-called wattle and daub (a composite building material used for making walls, in which a woven lattice of wooden strips called wattle is daubed with a sticky material usually made of some combination of wet soil, clay, sand, animal dung and straw). Through the next year we will be analyzing the composition of these clays to check, among other things, for evidence of exposure to fire and possible imprints of recognizable plant species. Recognizing and characterizing this type of technology in the Mesolithic levels of the shell mound can represent a big advance in our understanding of technological particularities of these populations, particularly in what regards to the combination of fire and clay, an essential combination to produce ceramics which, in this region, only appear in the archaeological record with the arrival of Neolithic populations.





Figure 8 - Preparation and removal of undisturbed block of sediment for sediment micromorphology analysis.  
Photo by ICArEHB.



Figure 9 - Fragments of consolidated clay.  
Photo by ICArEHB.

## PROJECT IMPACTS

### 1. Increasing Scientific Knowledge

#### a) Total citizen science research hours

*Provide an estimate for the number of hours per day that volunteers spent collecting data, being trained to collect data in the field, and performing data entry. Include in this estimate transportation from housing site to the field site, and all sorts of activity for which you would typically pay a technician.*

In 2018, 25 Earthwatch volunteers participated in the Muge expedition, ten for two weeks and fifteen for a week. On average, the volunteers spent eight hours a day doing research work, which included fieldwork (5 hours) and laboratory work (3 hours). Since all research activities were carried out in conjunction with the field and laboratory assistants, the necessary training for the accomplishment of the various tasks (e.g., excavation, archaeological materials processing) was carried out according to each task and whenever doubts arose. However, on the first day of each new team an introductory one hour lecture about the project background and goals was given.

After work activities (e.g., dinner) also helped the volunteers to deepen their knowledge on the Muge Mesolithic shell middens through the pertinent questions they put to the team and that, sometimes, gave rise to very interesting debates.

In total, the estimated number of hours volunteers dedicated to the project is around 1375.

#### b) Peer-reviewed publications:

At this moment the team is carrying out analyzes of archaeological materials and sediments for publication of at least one article in a peer-review journal before the beginning of the next Earthwatch expedition in Muge. Some of the previous peer-review publications of the team on the Cabeço da Amoreira shell midden are:

Gonçalves, C., André, L., Cascalheira, J. & Bicho, N., 2018. Der Muschelhaufen von Cabeço da Amoreira in Muge, Portugal. Ergebnisse der Archäologischen arbeiten des letzten jahrents (2007-2017). *Madriider mitteilungen*, 59: 1-21.

Gonçalves, C., Cascalheira, J., Costa, C., Bárbara, S., Matias, R. & Bicho, N., 2018. Detecting single events in large shell mounds: A GIS approach to Cabeço da Amoreira, Muge, Central Portugal. *Journal of Archaeological Science: Reports*, 18: 1000-1010.

Paixão, E., Marreiros, J., Pereira, T., Gibaja, J., Cascalheira, J., & Bicho, N., 2018. Technology, use-wear and raw material sourcing analysis of a c. 7500 cal BP lithic assemblage from Cabeço da Amoreira shell midden (Muge, Portugal). *Archaeological and Anthropological Sciences*, 1-21.

Bicho, N., Cascalheira, J., Gonçalves, C., Umbelino, C., García Rivero, D., & André, L., 2017. Resilience, replacement and acculturation in the Mesolithic/Neolithic transition: the case of Muge, central Portugal. *Quaternary International*, 446: 31-42.

Umbelino, C., Bicho, N., Perinha, A., Ferreira, T., Cunha, E., & Curate, F., 2016. Cortical bone loss in a sample of human skeletons from the Muge Shell Middens. *Archaeological and Anthropological Sciences*.

Aldeias, V. and Bicho, N., 2016. Embedded Behavior: human activities and the construction of the Mesolithic shellmound of Cabeço da Amoreira (Muge, Portugal). *Geoarchaeology*, 31(6): 530-549.

André, L. & Bicho, N., 2016. Perforation techniques and traces of use on the Mesolithic adornments of the Trench Area at Cabeço da Amoreira Shellmidden (Muge, Central Portugal). *Comptes rendus - Palevol*, 15(5): 569-580.

**c) Non-peer reviewed publications:**

*Technical reports, white papers, articles, sponsored or personal blogs*

The team will have to deliver a technical report to government heritage department reporting on the finds of 2018.

**d) Books and book chapters: N/A**

**e) Presentations:**

*Indicate if this was an invited paper, panel presentation, keynote speech, plenary address, or other.*

The team will present some papers in professional meetings in 2019:

Poster Presentation: *Muge Portal: A new digital platform for the last hunter-gatherers of the Tagus Valley, Portugal*

Conference name: 84<sup>th</sup> Annual Meeting of the Society for the American Archaeology

Conference location: Albuquerque, NM, USA

Dates: April 2019

Authors: C. Gonçalves, C. Umbelino and J. Cascalheira

Poster Presentation: *A Geometric Morphometrics approach to test microlith variability at Cabeço da Amoreira shellmidden (Muge, Portugal).*

Conference name: 84<sup>th</sup> Annual Meeting of the Society for the American Archaeology

Conference location: Albuquerque, NM, USA

Dates: April 2019

Authors: J. Belmiro, J. Cascalheira & C. Gonçalves



## 2. Mentoring

### a) Graduate students

List graduate students doing thesis work on the project and include student CVs and their research proposal on file with the university as an attachment (if possible) when you submit your annual report.

Student Name	Graduate Degree	Project Title	Anticipated Year of Completion
Lino André	PhD	Elementos de adorno pessoal e processos de adaptação cultural: dos últimos caçadores-recolectores às primeiras sociedades agro-pastoris do centro e sul de Portugal.	2019

### b) Community outreach

Provide details on how you have supported the development of environmental leaders in the community in which you work.

Name of school, organization, or group	Education level	Participants local or non-local	Details on contributions/ activities
Escola Secundária de Santarém	High school	André Policarpo	André is a high-school student who will make a short documentary about the Muge shell middens, specifically on our project goals and results. We believe the film will help to develop greater awareness on the importance of the Muge cultural heritage, not only for André and his colleagues and teachers, but also for the whole local community.

## 3. Partnerships

List your current active professional partnerships that contribute to your project and indicate the type of support these partners provide.

Partner	Support Type(s) <sup>1</sup>	Years of Association (e.g. 2006-present)
Casa Cadaval	Logistics	2008-present

<sup>1</sup>. Support type options: funding, data, logistics, permits, technical support, collaboration, academic support, cultural support, other (define)

## 4. Contributions to management plans or policies

List the management plans/policies to which your project contributed this year

Plan/Policy Name	Type <sup>2</sup>	Level of Impact <sup>3</sup>	New or Existing?	Primary goal of plan/policy <sup>4</sup>	Stage of plan/policy <sup>5</sup>	Description of Contribution
N/A	N/A	N/A	N/A	N/A	N/A	N/A

<sup>2</sup>. Type options: agenda, convention, development plan, management plan, policy, or other (define)

<sup>3</sup>. Level of impact options: local, regional, national, international

<sup>4</sup>. Primary goal options: cultural conservation, land conservation, species conservation, natural resource conservation, other

<sup>5</sup>. Stage of plan/policy options: proposed, in progress, adopted, other (define)



## 5. Conserving natural and sociocultural capital

### a) Conservation of taxa

i. List any focal study species that you did not list in your most recent proposal

Species	Common name	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source
N/A	N/A	N/A	N/A	N/A

ii. In the past year, has your project helped conserve or restore populations of species of conservation significance? If so, please describe below.

Species	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source	Description of contribution	Resulting effect <sup>6</sup>
N/A	N/A	N/A	N/A	N/A	N/A

<sup>6</sup> Resulting effect options: decreased competition, improved habitat for species, range increased, population increase, improved population structure, increased breeding success, maintained/enhanced genetic diversity, other

### b) Conservation of ecosystems

In the past year, has your project helped conserve or restore habitats? If so, please describe below.

Habitat type	Habitat significance <sup>7</sup>	Description of contribution	Resulting effect <sup>8</sup>
N/A	N/A	N/A	N/A

<sup>7</sup> Habitat significance options: nursery, breeding ground, feeding site, corridor, migration path, refuge, winter range, summer range, spring range, fall range or other (define)

<sup>8</sup> Resulting effect options: extent maintained, condition achieved, restored, expanded, improved connectivity or resilience

### c) Ecosystem services

Indicate which ecosystem service categories you are directly studying in your Earthwatch research and provide further details in the box below.

- ☐ Food and water
- ☐ Flood and disease control
- ☐ Spiritual, recreational, and cultural benefits
- ☐ Nutrient cycling
- ☐ Carbon sequestration

Details: N/A

### d) Conservation of cultural heritage

Provide details on intangible or tangible cultural heritage components that your project has conserved or restored in the past year.

Cultural heritage component <sup>9</sup>	Description of contribution	Resulting effect
Archaeological artifacts	We have collected thousands of artifacts from the Mesolithic shell mound of Cabeço da Amoreira. These are an essential component for a better understanding of past behaviors.	Detailed analysis of these artifacts are still ongoing.

<sup>9</sup> Cultural heritage component options: traditional agriculture, artifacts, building(s), hunting ground or kill site, traditional ecological knowledge and practices, monument(s), oral traditions and history, spiritual site, traditional subsistence living

## RESEARCH PLAN UPDATES

*Report any changes in your research since your last proposal/annual report. For any 'yes' answers, provide details on the change in the 'Details' box.*

- |   |                              |  |
|---|------------------------------|--|
| 1) Have you added a new research site or has your research site location changed? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 2) Has the protected area status of your research site changed?                   | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 3) Has the conservation status of a species you study changed?                    | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| 4) Have there been any changes in project scientists or field crew?               | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |

## ACKNOWLEDGEMENTS

We thank Earthwatch for funding and field support. To Casa Cadaval, owner of the lands where the Muge shellmiddens are located, for their logistic assistance to the field work, Earthwatch volunteers lodging in 2018, and protection of the archaeological sites during the last decades.



Team 1A. Photo by ICArEHB.



Volunteer Warren Stortroen. Photo by ICArEHB.





Volunteer Sallie McCutcheon and Roxane Matias at the sieving station. Photo by ICArEHB.



Team 1B. Photo by ICArEHB.





Team 2A. Photo by ICArEHB.



Volunteer Sanford Eguchi. Photo by ICArEHB.



Volunteer Patricia McKay. Photo by ICArEHB.





General view of the excavation area. Photo by ICArEHB.





Visit by the Countess D. Teresa Álvares Pereira Schönborn-Wiesentheid, CEO da Casa Cadaval and owner of the land where the shellmiddens are located. Photo by ICArEHB.



Team 2B. Photo by ICArEHB.





Team 3A. Photo by ICArEHB.



Sieving station. Photo by ICArEHB.





General view of the excavation. Photo by ICArEHB.



Team 3B. Photo by ICArEHB.