

PART A

1 *Research Project Title*

Rediscovering Altamura. Advanced multidisciplinary investigations on the skeleton from the Lamalunga cave, Italy.

Nickname: **The KARST project**

(Knowing the Altamura man thRough Science & Technology)

2 *Duration (months)*

36 months

3 *Main ERC field*

LS - Life Sciences

4 *Possible other ERC field*

SH - Social Sciences and Humanities

5 *ERC subfields*

1. LS8_5 Evolutionary biology: evolutionary ecology and genetics, co-evolution
2. SH6_3 Prehistory, palaeoanthropology, palaeodemography, protohistory
3. LS8_3 Systems evolution, biological adaptation, phylogenetics, systematics, comparative biology

6 *Key Words*

4. HUMAN EVOLUTION
5. NEANDERTHAL
6. SOUTHERN ITALY

7. MID-TO-LATE PLEISTOCENE
8. CONSERVATION

7 *Principal Investigator*

Giorgio MANZI, Professore Ordinario

8 *List of the Research Units*

Group leader	Category	Univ./Institution	E-mail address
1_ Giorgio MANZI	Prof. Ordinario	Università di ROMA "La Sapienza"	giorgio.manzi@uniroma1.it
2_ Iacopo MOGGI -CECCHI	Prof. Associato confermato	Università di FIRENZE	iacopo.moggicecchi@unifi.it
3_ Damiano -MARCHI	Prof. Associato (L. 240/10)	Università di PISA	damiano.marchi@unipi.it

9 *Research project abstract*

The paleoanthropological specimen referred to as "Altamura man", discovered in 1993 within the Lamalunga karst system, near the town of Altamura (Puglia, Italy), might well be the most complete Neanderthal specimen ever discovered and represents the most ancient Neanderthal from which endogenous DNA has been extracted. Despite its importance for the knowledge of human evolution in Europe during the Mid-to-Late Pleistocene, the specimen is still in situ, largely incorporated within a curtain of calcite and coralloid concretions. Yet, a multidisciplinary project started in 2008 and allowed the extraction of an isolated portion of the skeleton (fragment of scapula) together with some calcite samples. The first results of this new generation of studies concur in indicating that the skeleton from Altamura belonged to a Neanderthal, albeit with significant peculiarities in its morphology, with a chronology ranging from 172 ± 15 ka to 130 ± 2 ka. In the last years there were further achievements, including the acquisition, through high-resolution laser scanning and photogrammetry, of the whole karst system and the visible bones of the skeleton.

The present project is the continuation of that scientific endeavour both in methodologies and for large part of the scientific team involved. Our intention is to carry out a complete multidisciplinary survey on the specimen, including chronology, skeletal biology, taphonomy, evolutionary history and ecology. The project will be co-directed with the Soprintendenza Archeologia della Puglia and in agreement with the Municipality of Altamura. It will be performed by 3 Research Units (RU), including academic profiles from the Universities Sapienza (Roma 1), Roma Tre, Torino, Firenze and Pisa, differentiated by specific scientific skills and expertise, besides the collaboration with a specialized staff, including academic and non-academic technical profiles. The RUs will work with full autonomy, while at the same time a close interaction between them is required by the project. The work will

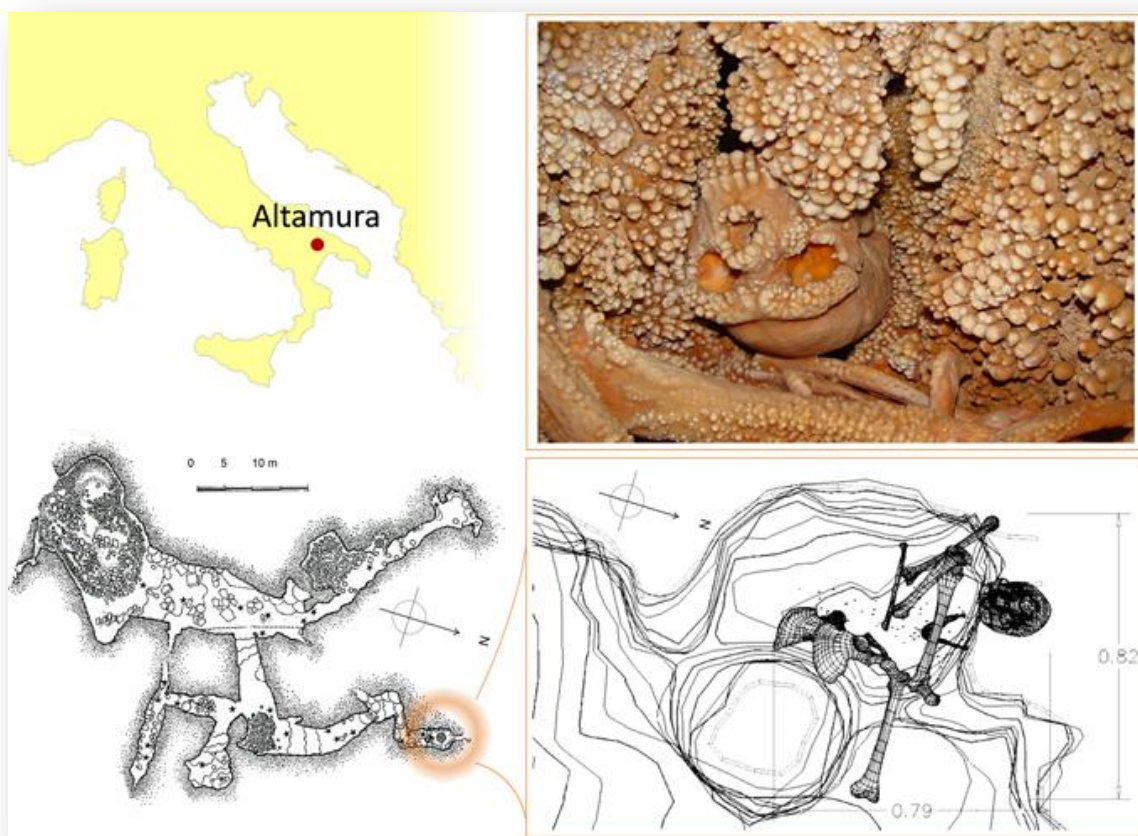
progress across time (a time schedule is furnished), distinguished in three main “phases”: 1) site-based analyses; 2) lab-based analyses; 3) conservation (see Part B, #12).

The project aims also at creating ideal conditions for the preservation and future musealization, in the town of Altamura, of the Neanderthal skeleton. Hence, we plan to carry out a “controlled re-aligning” of the chemical and physical conditions, so as to guarantee the ideal state of preservation, which will allow for future research. The procedures applied for the study and conservation, as well as the development of a protocol addressed to the future extraction and conservation of the skeletal remains make this project scientifically and technologically innovative. The results will be communicated to the scientific community and to the general audience; this will produce a significant impact for the cultural and socio-economic development of both the town of Altamura, the Parco Nazionale dell’Alta Murgia, the Region Puglia, and Italy as a whole.

PART B

10 State of the art

In October 1993, an archaic (i.e., non modern) human skeleton was discovered in the Lamalunga cave, near Altamura in Puglia, Italy. For the excellent state of preservation, the absence of deformation and the probable occurrence of the entire skeleton, the paleoanthropological specimen referred to as "Altamura man" represents an exciting paleoanthropological discovery.



Together with a few other case-studies, diluted in more than 3 million years, it represents a

rare example of a virtually complete hominin skeleton before the occurrence of intentional burials. The preservation of this massive adult male skeleton is exceptional, although it is largely incorporated within calcite concretions. However, the skeletal remains have never been extracted from the cave and no detailed examination has ever been possible in the past, but for some visual documentation [1-3]. Nevertheless, the finding has attracted the attention of the scientific community and the media since its discovery, with a broad coverage at both national and international level [4].

Most of the bones are clearly visible among the karst formations, such as the cranium reversed on its vault, the mandible, and several postcranial elements including long bones, the pelvis, ribs, and vertebral bodies. Visible features denote a mixture of archaic and derived (i.e. Neanderthal) traits, which fit within the range of variation displayed by the European hominins of the Mid-to-Late Pleistocene. Although Neanderthal traits dominate the scene, in fact, there are features that separate this specimen from a “classic” morphology [5]. For instance, the facial districts display an advanced degree of midfacial prognathism with inflated maxillary sinuses, but the vault is more archaic than the face in its general appearance: particularly the parietals appear angulated in coronal section, while the mastoids are big and projecting downward. By contrast, the occipital appears definitely Neanderthal-like in many respects – including a double-arched occipital torus and a clearly expressed suprainiac fossa – whereas the brow-ridge morphology underneath the calcareous concretions does not seem typical for a Neanderthal, since each supraorbital region appears massive and with a marked distinction between its medial and lateral components.

In 2008 a new scientific endeavour started by the appointment of the Direzione Regionale per i Beni Culturali e Paesaggistici della Puglia, in collaboration with the Soprintendenza Archeologia della Puglia, and some of the participants to the present research project. The new team, assisted by speleologists of the Centro Altamurano Ricerche Speleologiche, physically removed samples to be used for absolute dating, ancient DNA (aDNA) extraction and quantitative morphological studies.



More in detail, in July 2009, the articular portion of the right scapula was extracted from the cave with the aid of telemanipulators equipped with light and a micro-camera, following a specifically developed sampling procedure inspired by laparoscopic surgery; all the measures required to prevent DNA contaminations were followed. First results of the new analyses were presented in a monographic volume in 2011 [6], and in more extensive and detailed papers in 2015 and 2016 [7,8]. Overall, the results concur in indicating that the Altamura specimen belongs to the hypodigm of *Homo neanderthalensis*, while its phenetic peculiarities appear consistent with a chronology ranging from 172 ± 15 ka to 130.1 ± 1.9 ka.

In 2014-2015, new achievements were also reached, in particular: a) the complete acquisition, through high-resolution laser scanning and photogrammetry, of the whole karst system and the cranial and post-cranial elements of the human skeleton; b) the recovery in sterile conditions of additional fragments of the right scapula extracted in 2009.

The work done in the last years represents the necessary and appropriate prelude for the current research project. Moreover, it is particularly remarkable and promising that the skeleton of the Lamalunga cave is probably the most complete Neanderthal specimen ever discovered and the most ancient Neanderthal from which endogenous DNA has ever been extracted.

References

1. Micheli M., Piperno M., Vacca E. (eds) 1996. L' uomo di Altamura e la grotta di Lamalunga. Abaco, Forlì.
2. Pesce Delfino V., Vacca E. 1993. Rivista di Antropologia 71, 249-257.
3. Vacca E., Pesce Delfino V. 2004. Collegium Antropologicum 28, 113-119.
4. Nature Research Highlights 2015. Nature 520, 8 (doi:10.1038/520008a).
5. Manzi G., Magri D., Palombo M.R. 2011. Sci. Rev. 30, 1420-1438.
6. Aa.vv. 2011. DiRe in Puglia 2, 1-70.
7. Lari M. et al. 2015. Journal of Human Evolution 82, 88-94.
8. Di Vincenzo F. et al. 2016. Atti XLVII Riunione Scientifica Istituto Italiano di Preistoria e Protostoria.

11 Detailed description of the project: methodology, targets and results that the project aims to achieve and their significance in terms of advancement of knowledge

This project entails a multidisciplinary high-level scientific investigation of the human skeleton known as the “Altamura man”, discovered within the Lamalunga karst system in the Alta Murgia (Altamura, Puglia). We will work in co-direction with the Soprintendenza Archeologia della Puglia, tackling taphonomy, chronology, morphology, paleoecology and paleogenetics of this archaic specimen, so as to contribute to our understanding of human evolution in Europe during the Mid-to-Late Pleistocene.

We also aim at promoting the preservation and a future musealisation in the town of Altamura, of this remarkable specimen. The project represents the continuation – for methods applied, goals and scientific team involved – of a more recent phase of multidisciplinary investigations. The significant results obtained in the previous stages (see ‘state of the art’ section) call for a progression of the studies on the Altamura skeleton and of the system of karst cavities where it was found. This necessary advancement represents a rare opportunity to apply cutting- edge technologies in the field of cultural heritage and paleoanthropology for the study and conservation of the better-preserved Neanderthal specimen ever found.

In order to perform the activities mentioned above, we have created 3 Research Units (RU) led by experts in their respective fields of research. We also plan to recruit leading figures and dedicated laboratories/instruments for a number of specialized analyses.

The first part of investigations will consist of a period of monitoring and observation of the Lamalunga cave. The monitoring of parameters such as air temperature, relative humidity and CO₂ concentrations are the prerequisite for the microclimate characterization of the cave passage in which the Neanderthal bones are located. All activities in the cave will be planned in agreement with the Soprintendenza Archeologia della Puglia and will be documented in detail.

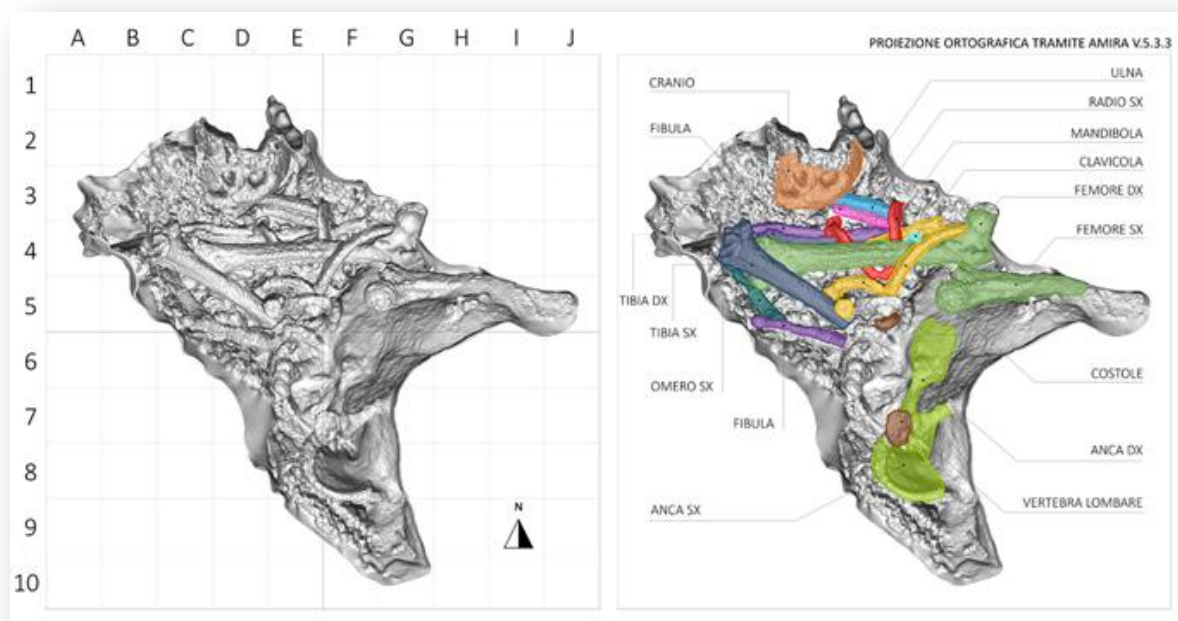
1a) Environmental monitoring of the Lamalunga cave with microclimate and hydrochemical study of the cave passages: the thermo-igrometric state of the complex and its evolution are defined, in time and space, by significative, measurable parameters such as air temperature and relative humidity, artificial lighting, air velocity, superficial temperature of the complex and its remains, as well as – for what concerns karstic phenomena and the stability of the complex and associated remains after their removal – the characterization of water in its specific context. All this has the aim to interpret the entity of energy exchanges between the cave environment and the remains. The microclimatic investigation of the Lamalunga cave aims at defining pivotal thermo-igrometric events, which might be critical for the remains.

1b) In-situ and virtual study of geoarchaeology and taphonomy: the processes of formation of the Altamura complex have been investigated in earlier approaches although they were strongly limited by the scarce hospitability of the site. Through the digital acquisition and photogrammetry of the entire complex of the “abside dell’uomo” we will have the chance to perform studies in a 3D environment. The purpose of the geoarchaeological and taphonomic study of the Lamalunga site is to contextualize the set of human remains from the points of view of palaeoenvironment and human behaviour. Two main questions summarise these aspects: which were the environmental conditions when the bones accumulated within the cave? Why and how did those bones ended up into a peculiar underground location that was not otherwise frequented by humans?

The bones are rather far from the probable original entrance of the cave, a vertical pit now occluded, where the individual may have fallen in. Faunal remains found in some of the galleries are often isolated bony elements accumulated in depressed areas of the cave, suggesting that they were transported and dispersed by water. This was not the case with the human skeleton, given that it is largely represented and concentrated in a small area. Thus, it may be hypothesized that, after death and decomposition of the body, the skeleton collapsed where it has been found. No lithic tools have been found so far in the cave.

The geological study of the cave and of its infilling sediments can be used to reconstruct site formation processes, including the opening of new entrances and the closing of the original ones; sediment studies will highlight internal processes of erosion and accumulation, which may have caused the displacement of the human remains. Such studies can also provide high quality information about past climate, because caves act as sediment traps preserving records of environmental processes. The analysis, in situ and/or digitally performed, of the external morphology of bones could highlight possible specific fracture/modification patterns, surface wear or other aspects indicating the modality of accumulation and/or carnivore or human modification. If used in association with geoarchaeological studies, the taphonomic analysis can be an extremely powerful tool to reconstruct the peri- and post-mortem history of the bone assemblage.

1c) Monitoring and digital acquisition (through laser scanning and photogrammetry) of the so-called “abside dell’uomo” and the “Altamura man”: during 2015 some members of our team collaborated to the realization of a 3D high resolution laser scanner and complete photographic survey of the skeleton of the Altamura Man and of the karst cavity of Lamalunga. Virtual scans and photographs were acquired and processed with specific software, such as Leica Cyclone and Agisoft, helpful to merge scans into a single system of reference, to reduce noise and to verification of coverage of the RGB data. Starting from the same corpus of data and improved methodology, in this first phase of the project we will accomplish the documentation on the 3D topographic disposition of the skeletal elements within the “abside dell’uomo”.



1d) Virtual planning and definition of a protocol for a possible future removal and preservation of the bony elements preserved in the “abside dell’uomo” and in the small chamber. The human activities occurred in the cave during the years immediately subsequent to the discovery have produced disturbances and variations in the environmental and microclimatic conditions of the cave. The high levels of humidity and the optimal values of pH recorded in the cave are favourable to the development and the growth of microbial life. This growth of algae and others microorganisms in direct contact

with the human remains can produce, in perspective, serious and maybe irreversible damages. In this perspective, we will develop a detailed protocol to use in the case of the eventual extraction of the skeletal elements, and their conservation in stable condition (i.e. 25 °C, 45% of relative humidity in the air). Before any possible attempts to remove some of the bony elements from the cave it is paramount to simulate the extraction protocol to reduce unnecessary disturbances. The main areas of contact between the remains and the karstic structures are: a) the so-called “coralloid formations”, which constitute bridges among the stalagmitic system and the skull; b) concretions adhering for a limited thickness. It is thus possible to plan, once the feasibility is verified by the preliminary studies, an extraction executed by qualified figures using techniques of visualization and manipulation inspired by laparoscopic surgery. Following the digital acquisition using laser-scanner and photogrammetry of the main visible skeletal elements in the “abside dell’uomo” we plan the following activities 2a and 2b.

2a) digital restoration of the virtually extracted bones: All the bony elements of the Altamura skeleton are incorporated in calcite concretions of various thickness and any attempt to chemically or mechanically remove this hard matrix can be a potentially destructive procedure. However, the recent advancements in 3D digital acquisition allowed the large application of the so-called Virtual Anthropology as a standard protocol in the study and preservation of specimens of anthropological relevance. It allows the non-invasive study of some external anatomical structures, and their digital restoration and preservation in conditions of total safety for the original materials.

2b) Morphological study/reconstruction of the virtually extracted cranial (i) and post-cranial (ii) skeletal districts: i) Using a combination 3D imaging technology, geometric morphometrics and multivariate statistics it becomes possible to obtain a very large amount of information from the Lamalunga skeleton to improve our knowledge on the functional anatomy and phylogeny of archaic humans. The cranium and mandible of the “Altamura man” exhibits a unique combination of archaic and more advanced features towards the typical Neanderthal condition. In this view the study of this material becomes crucial for the understanding of the complex evolutionary dynamics that led to the emergence of the Neanderthal morphs. ii) The study of the postcranial skeleton provides an invaluable means to understand the lifestyle of extinct species. While traditional metric methods are still valuable to provide a first description of a fossil specimen, other methods that rely on the biomechanical and morphometric characterization of the postcranial skeleton bones are more informative to assess changes in the locomotor modes and body shape of extinct hominins and their relationships with other specimens/species. The aim of the study of the Altamura skeleton is to provide a complete functional/morphological characterization of the postcranial elements available. Morphometric analysis, associated with biomechanical studies, will allow a better appreciation of the functional and phenetic position of this early Neanderthal specimen within the European context.

Alongside with the virtual extraction and digital restoration of the bony elements, it will be attended the physical extraction, from the “abside dell’uomo” and the small chamber, of some of the smaller bony elements not appearing largely incorporate in calcite concretions. On these bony materials we plan the following activities 2c-2f.

2c) aDNA analysis: so far, the skeleton from Altamura represents the most ancient Neanderthal from which endogenous DNA has ever been extracted. In order to describe in depth the genetic relationship between this archaic Neanderthal and other hominids, our

main goals will be: i) to reconstruct and phylogenetically analyze the complete mitochondrial genome of the sample; ii) to genotype a large number of informative single nucleotide polymorphisms (SNPs) and to compare them with the available data from both other ancient hominids and modern humans. We will also try to infer some phenotypic traits of this extraordinary human sample.

2d) U-series dating: in karst caves, the more reliable way to indirectly date human remains older than 50 ka is the U-series dating of calcite crusts that commonly coated the bones. This approach has been utilised for the preliminary dating of the “Altamura man” yielding two possible ante quem ages of 130 ± 2 ka and 55 ± 2 ka respectively. However, the obtained U-series ages need to be confirmed with a second batch of analyses, since the calcite in direct contact with the bones can be affected by U-mobilisation that alters age calculation. This part of the project aims at sampling and dating with the U-series method a statistically significant number of calcite deposits (coralloid formations and crusts) in direct contact with the Neanderthal bones in order to obtain a robust ante quem age of the bones. Similarly, the dating of fossil speleothems underneath the bones will reveal the actual minimum age limit of the Neanderthal skeleton.

2e) Petrographic and paleoclimate study: a detailed petrographic and high-resolution trace element and isotopic study will be carried out on the calcite deposits in order to assess possible diagenetic modifications that can affect the U-mobilisation and the age determination. Moreover, these analyses will give insights on the environmental and climate conditions during the different growth phases.

2f) Isotopic studies of bony and dental elements: we plan to perform a detailed isotopic investigation on parts of the skeleton and – whether available – dental elements. The analyses aim at measuring the composition and isotopic ratios of strontium, oxygen, carbon, and nitrogen. Minimally destructive methods will be applied (i.e. LA-MS) to obtain dietary and environmental proxies that might be reconnected with our understanding of the upper Pleistocene and could help to better define subsistence strategies among Neanderthal groups.

2g) Dental morphological and microwear analyses: the possibility to study the cranium and mandible of the Altamura Neanderthal specimen offers the opportunity to examine in detail numerous aspects of its dentition. The completeness of the specimen will allow us to perform a broad range of analyses (e.g. geometric morphometrics, microwear, pathologies), which will provide a series of information on different aspects of the biology and lifestyle of the individual. The multi-faceted approach to the study of the dentition will allow the comparison with similar data already available on other Pleistocene samples from different areas of Eurasia and from different time periods, in order to document affinities or differences with other populations of Neanderthals, possible micro-evolutionary and specific adaptive events in the Neanderthal lineage.

12 Project development, with identification of the role of each research unit and research organizations involved, with regards to expected targets, and related modalities of integration and collaboration

The project development will be performed by 3 Research Units (RU), differentiated by specific scientific expertise, as will better emerge in the following sections.

The RUs will work under the aegis of the Soprintendenza Archeologia della Puglia and in agreement with the Municipality of Altamura, with the collaboration of academic and non-academic technical profiles.

The RUs will work with full autonomy and, at the same time, in close interaction; the execution and progress of each unit will be monitored and coordinated with the others, while periods of overlapping are planned. The three-phases organization will progress across time with each RU developing different aspects of the project, as follows.

DIPARTIMENTO DI BIOLOGIA AMBIENTALE

SAPIENZA
UNIVERSITÀ DI ROMA

Roma, 11 gennaio 2016

Dr. Luigi La Rocca
Soprintendenza Archeologia della Puglia
Via Duomo 33, 74100 Taranto

Oggetto: Progetto "KARST" (PRIN bando 2015, prot. 2015WPHSCJ) e definizione convenzione

Illustre Soprintendente,

è con grande piacere che Le allego una descrizione del progetto "KARST", riguardante lo studio e la conservazione dello scheletro neandertaliano della grotta di Lamalunga presso Altamura, predisposto per una richiesta di finanziamento nell'ambito dei Programmi di Ricerca di Interesse Nazionale (PRIN - bando 2015, prot. 2015WPHSCJ).

Il progetto, di durata triennale, prevede la partecipazione di specialisti della ricerca scientifica in paleoantropologia - colleghi delle università di Roma Tre, Firenze e Pisa - e coinvolge anche alcuni esperti nell'ambito della conservazione e dello studio dei sistemi carsici e/o umidi afferenti all'EURAC, all'U.S.C.R. e alla University of Newcastle (Australia).

Mi auguro che la stesura del progetto risponda adeguatamente alle istanze di conoscenza, salvaguardia e valorizzazione dello straordinario contesto, istanze già condivise con codesta Soprintendenza, che persegue la tutela dell'importante giacimento di Lamalunga come proprio compito istituzionale, con esito invero assai favorevole nel corso delle comuni attività di ricerca e valorizzazione degli ultimi anni.

In questa direzione, come abbiamo anche avuto modo di condividere per le vie brevi, sarà certamente auspicabile arrivare quanto prima alla stipula di una convenzione tra la Soprintendenza Archeologia della Puglia e la Sapienza Università di Roma (cui afferrisce l'unità proponente il progetto e da me coordinata), che possa sostenere le attività di terreno, di laboratorio e quelle rivolte alla conservazione e valorizzazione dell'importante reperto.

In attesa di un Suo gentile riscontro, Le porgo i più cordiali saluti

Prof. Giorgio Manzi
Paleoanthropology - Human Ecology & Primatology
Museum of Anthropology «Giuseppe Sergi» (director)

Department of Environmental Biology
Piazzale Aldo Moro 5, 00185 Roma (Italy)

DIPARTIMENTO DI BIOLOGIA AMBIENTALE

SAPIENZA
UNIVERSITÀ DI ROMA

Roma, 11 gennaio 2016

Prof. Giacinto Forte, Sindaco di Altamura
Piazza Municipio 1, 70022 Altamura (BA)

Oggetto: Progetto "KARST" (PRIN bando 2015, prot. 2015WPHSCJ)

Egregio Signor Sindaco,

è con grande piacere che Le allego il progetto "KARST", riguardante lo studio e la conservazione dello scheletro neandertaliano della grotta di Lamalunga presso Altamura, predisposto per una richiesta di finanziamento nell'ambito dei Programmi di Ricerca di Interesse Nazionale (PRIN).

Il progetto, di durata triennale, prevede - oltre all'unità di ricerca della Sapienza da me coordinata - la partecipazione di altri specialisti della ricerca scientifica in paleoantropologia - colleghi delle università di Roma Tre, Firenze e Pisa - e coinvolge anche alcuni esperti nell'ambito della conservazione e dello studio dei sistemi carsici e/o umidi afferenti all'EURAC, all'U.S.C.R. e alla University of Newcastle (Australia).

Mi auguro che la stesura del progetto confermi il Suo interesse in rapporto alle istanze di conoscenza, salvaguardia e valorizzazione dello straordinario contesto di Lamalunga, oltre che nella prospettiva di ulteriori passi da fare insieme in questa direzione, visto che il reperto così com'è ora non è certo in uno stato di conservazione ideale né esso è accessibile alla fruizione culturale e (perché no?) emozionale da parte della cittadinanza e dei turisti.

In attesa di un Suo gentile riscontro, Le porgo i più cordiali saluti

Prof. Giorgio Manzi
Paleoanthropology - Human Ecology & Primatology
Museum of Anthropology «Giuseppe Sergi» (director)

MODULO
B.C. - 201

**Ministero dei Beni e delle
Attività Culturali e del Turismo**

SOPRINTENDENZA ARCHEOLOGIA
DELLA PUGLIA - TARANTO

Taranto 14/1/2016

Università La Sapienza di Roma
Dipartimento di Biologia Ambientale
Prof. G. Manzi
P.le A. Moro, 5
00185 ROMA

Prot. N° 325
Ch. 31.10.04

**Oggetto: Altamura (BA). "KARST" (PRIN bando 2015, prot. 2015WPHSCJ) e
definizione convenzione. Rif. nota 11 gennaio 2013.**

In riferimento all'oggetto, si esprime piena condivisione alle linee progettuali espone nella bozza trasmessa e relative allo studio e alla conservazione dello scheletro neandertaliano della grotta di Lamalunga presso Altamura auspicandone il finanziamento nell'ambito dei Programmi di Ricerca di Interesse Nazionale (PRIN bando 2015, prot. 2015WPHSCJ).

Si condivide al tempo stesso la necessità di stipulare, in tempi brevi, una convenzione tra questa Soprintendenza e l'Università di Roma "La Sapienza" al fine di regolare e meglio condividere ogni attività di ricerca sul reperto paleo antropologico di Altamura in considerazione della competenza esclusiva della Soprintendenza in materia di tutela e conservazione e della necessità di collaborazione con istituzioni scientifiche di elevata specializzazione nelle attività di studio, documentazione e pubblicazione, quindi valorizzazione, del reperto.

Sarà cura pertanto dei rappresentanti di entrambi gli Enti prendere contatti per definire i contenuti della convenzione e predisporre quanto prima un testo condiviso.

IL SOPRINTENDENTE
dot. Luigi LA ROCCA

Soprintendenza Archeologia della Puglia
Via Duomo, 33 I - 74100 Taranto. Tel. + 39 099-4713511, fax + 39 099-4600128.
E-mail: sar-pug@beniculturali.it

CITTA' di ALTAMURA

I SETTORE - UFFICIO DI GABINETTO -
Piazza Municipio, 1 - 70022 ALTAMURA (BA) Tel. 080/3141019 Fax: 080/3141502
Codice Fiscale 82002590725 Partita IVA 02422160727
e-mail: sindaco@comune.altamura.ba.it

Comune di Altamura
U - 14/01/2016 - 0002314

Egr.
Prof. Giorgio Manzi
giorgio.manzi@uniroma1.it

Dipartimento di Biologia Ambientale
Università La Sapienza
P.le Aldo Moro 5, 00185
ROMA (Italy)

**Oggetto: Progetto "KARST" (PRIN bando 2015, prot. 2015WPHSCJ) -
riscontro nota dell'11.01.2016**

Chiar.mo prof. Manzi,

la ripresa degli studi e la corretta conservazione dello scheletro neandertaliano della grotta di Lamalunga presso Altamura è un'attività auspicata da anni da tutta la comunità locale. Tale attività non può che trovare piena apertura e disponibilità da parte dell'amministrazione che dirigo. Mi auguro davvero che sia l'inizio di una nuova stagione di approfondite ricerche su un reperto così raro e interessante, che attragga l'interesse di studiosi e gente comune ai fini alti della conoscenza scientifica, della salvaguardia e della piena valorizzazione dello straordinario insieme paleoantropologico.

Prendo inoltre con piacere atto della disponibilità dimostrata a valutare prospettive di ulteriori passi da fare insieme in questa direzione anche con riferimento alla piena fruizione culturale ed emozionale da parte della cittadinanza e dei turisti.

Altamura, lì 14 Gennaio 2016

IL SINDACO
Prof. Giacinto FORTE

PHASE 1: SITE-BASED ANALYSES

This phase shall engage the first 6 to 12 months of the project and will mainly involve RU1 (with collaborators of ISCR, Roma; EURAC, Bolzano; University of Newcastle, Australia) and RU3, participating for specific aspects. The main aim is to monitor present-day conditions of the cave and the skeletal remains to assess if/to what extent prior interventions have influenced the state of preservation of the context.

Multichannel dataloggers (temperature, relative humidity and CO₂) specifically developed for the long-term monitoring in remote cave environment will be used. The results of the study will form the backbone for the assessment of the present-day environmental condition inside the cave and give invaluable insights for the preservation of the skeletal remains.

A detailed geological mapping of the cave will include speleothem types and shapes, possible occurrence of false pavements and associated sediments testifying to previous phases of cave infilling and erosion.

Sediment sampling inside and outside the cave, for standard physical and chemical analyses (grain-size, density, organic carbon, CaCO₃), detail chemical analyses (SEM-EDX) and soil micromorphology (thin sections) will be carried out. Limited survey of the cave infilling sequence may be necessary for this purpose.

Ground-penetrating radar survey of the outside cave catchment could highlight possible alternative entrances, now closed, and contribute to explaining the presence of human bones.

Taphonomic studies will include the analysis of faunal and human bone modification (weathering, transport, intentional versus unintentional fracturing, carnivore modification etc.) to be carried out by stereomicroscope and scanning electron microscope.

The development of a protocol for the preservation of the bone in natural condition (using a procedure of progressive dehydration of the bone covered by the calcitic concretions without the use of any chemical substances) will be tested on available bony fragments, which removal will be carried out using manually-controlled devices so as to guarantee maximum control, replicating the operations similar to those already applied. The removed elements of paleoanthropological interest will be placed in special containers, which will guarantee internal micro-climate, monitoring devices (in wi-fi), resistance to external mechanical disturbances, and protection against shocks and contamination.

PHASE 2: LAB-BASED ANALYSES

The second phase of the project will start only in the case the feasibility of the extraction of isolated bony fragments or elements is confirmed or, in alternative, they are identified as free by concretions and easily removable.

This is the longest phase of the project (24-30 months), which will start after about 6 months of initial monitoring and in-situ work, and will likely last for the remaining part of the project. The RUs involved are mainly: RU1, for taphonomic, morphological and isotopic studies of the skeleton; RU2, for both dental analysis and aDNA extraction, and RU3 for morpho-functional studies. We also plan to involve the University of Newcastle (Australia) for U-series dating of the skeletal elements and speleothems.

The digital restoration of the virtually extracted bony elements will be performed using a Geometric Morphometrics approach. These approaches will allow to contextualize the “Altamura man” within the human mid-to-late Pleistocene variability. For the post-cranial skeleton, the same analyses will be applied in addition to biomechanical investigation through cross-sectional geometry and trabecular bone analyses with the aim of gathering information on the activity patterns of the individual.

The aDNA analysis will use a Next Generation Sequencing-based approach to obtain massive amounts of DNA data from this exceptionally preserved sample. Genomic libraries will be prepared by following a single-stranded protocol that maximizes the recovery of very short DNA molecules. Both human mitochondrial genome and nuclear DNA will be enriched by a capture approach that allows efficient sequencing of targets that are present in complex mixtures, such as ancient DNA extracts. Sequence data will be analyzed by means of specific bioinformatics tools to detect the presence of modern human contamination background and to distinguish authentic sequences likely from contaminant ones.

The U-series dating aims to precisely date the skeletal remains by analyzing a statistically significant number of calcite deposits (coralloids and crusts) in direct contact with the Neanderthal bones. A detailed optical petrography, stable isotopes ($\delta^{18}\text{O}$ and $\delta^{13}\text{C}$) and trace elements study (by means of LA-ICP-MS - Laser Ablation Ion Coupled Plasma Mass Spectrometry) will be carried out on the calcite samples in order to assess possible diagenetic modifications that can compromise the age determination. These analyses will give insights on the climate conditions and environmental evolution at the site. Following this screening, the best calcite samples will be chemically processed via dissolution, spiking and elution in spec-selective ion-exchange resins. Measurements will be made by a multicollector ICP-MS.

The isotopic study of bony and dental elements will require the extension of an existing RTD contract, with two main goals: on the one hand obtain paleoenvironmental data that will contribute to the reconstruction of the past environment of this Mid-to-Late Pleistocene context, on the other to obtain paleodietary information of the “Altamura man”. This entails the measurement of stable oxygen ($\delta^{18}\text{O}$) and carbon ($\delta^{13}\text{C}$) isotopes in the human dental phosphates, through minimally destructive methods such as a laser ablation / gas chromatography / isotope ratio mass spectrometry system (LA-GC-IRMS). The strontium isotope ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) will also be measured in the human tissues to better explore the relations with the local geology. Similar non-destructive procedures will be applied. The associated fauna found inside the “abside dell’uomo” will also be analyzed as reference material, bearing in mind that the human and animal contexts are likely to have significantly different chronologies.

The collection of samples for lab-based analyses will be agreed with the Soprintendenza Archeologia della Puglia and documented accordingly. The transfer of samples will follow agreed security procedures. All data obtained will be delivered to the Soprintendenza.

PHASE 3: CONSERVATION

The final phase will approximately cover the last year of the project and will mainly involve components of RU1 with the collaboration of EURAC (Bolzano) for the creation of ideal preservation conditions for both the site and the bony elements that have been possible to

extract. All of the necessary procedures and protocols necessary for an ideal preservation of the remains. In particular:

1. safe handling and transportation;
2. transfer to a sterile environment with monitoring of the micro-climate conditions;
3. conservation and aligning of environmental, chemical and physical conditions within accepted ranges. Throughout the analytical phase all skeletal elements and selected samples will be kept in special containers and transferred to the various labs for analyses.

Any bony element or fragment will be kept in a hermetic environment with controlled micro-climatic conditions. Such conditions can be set and modified to foster a better conservation. This system guarantees elevated resistance to external disturbances; hermetic protection against liquids and gasses; safe lock; UV rays protection. Once equilibrium is reached the remains can move to a further conservative step, which might entail a re-aligning of chemical and physical parameters that guarantee preservation for study and musealisation.

13 Possible application potentialities and scientific and/or technological and/or social and/or economic impact of the project

The innovative procedures applied make this project scientifically and technologically innovative. The results will be communicated to the scientific community and to the general audience; this will produce a significant social and cultural impact, contributing for the further development of the town of Altamura (including tourism), within the Parco Nazionale dell'Alta Murgia.

The significance of the human skeleton from the Lamalunga cave has many aspects of interest. On the basis of previous surveys, the skeleton appears to have fossilized at the place of death. Following the diagenetic processes of post-mortem disarticulation, the whole skeleton has remained confined to a limited area in an excellent state of preservation given the particular micro-climatic conditions and the absence of any disturbance. Within the world scientific scenario, the Altamura case represents a unicum, as it provides the scientific community, as well as the general public, with the chance to know every aspect of the skeletal anatomy of a single individual of *Homo neanderthalensis*. Despite the many fossils of this species found in Eurasia, including Italy, the skeletal elements found are often fragmentary if not isolated and heterogeneous for sex and age at death. The opportunity to study a complete skeleton, with no taphonomic distortions, for which it will be possible to estimate sex, age at death and detect possible pathologies and other data on life history, is unprecedented, also considering the extraordinary findings of the Dinaledi Chamber in South Africa and the European evidence from Sierra de Atapuerca in Spain. We will have the chance to produce a vast high-impact literature on specific aspects that will echo in the scientific community and among the general audience. In particular, morpho-functional and evolutionary data will become available to scholars thanks to the application of cutting-edge techniques and the involvement of leading experts in their respective fields. We plan to make available to the international scientific community digital information on the skeletal elements from Lamalunga, which will open up to a new season of investigations.

Given its antiquity and in consideration of some cranio-dental plesiomorphic traits, the Altamura fossil skeleton can be placed at an early phase of the Neanderthal evolution. Its

investigation can thus provide vital information on the origin and following diffusion of this taxon in Europe during the Pleistocene. In particular, the focus on the southern regions of Italy becomes of extreme interest in consideration of the particular environmental evidence, which reveals profound climatic fluctuation that will be tackled through a systematic isotopic investigation.

Molecular data indicate that the Neanderthal evolutionary lineage split from the African forms that led to the emergence of our species before 500 Ka. According to the same aDNA data, Neanderthals came in secondary contact, possibly also through genetic admixture, with *Homo sapiens* with the spread of the latter out of Africa definitively around 60-70 ka. However, this evidence remains controversial, and the hypothesis of a common ancestry cannot be ruled out. In this perspective, the Lamalunga gene pool antedates of about 100 thousand years any evidence of possible admixture *H. neanderthalensis*/*H. sapiens*, becoming a paramount contribution to the recent debate.

The scientific analysis will consider the delicate nature of this context and will represent the backbone of the recently inaugurated Museum System “Uomo di Altamura”.

The results of the project will be communicated in a conference for the scientific community. The participants to the project will also deliver talks and papers on specific aspects in their respective fields of research. We also envisage various events to communicate our results to the general audience, either in the Apulian context or at the national and international level.

The presentation of the outcomes of the project will also take place at sites agreed with the Soprintendenza Archeologia della Puglia. In addition, we plan to produce monographs on the “Altamura man”, for the scientific community and for the popular audience.