

## ***New applications for mosaics conservation at Butrint UNESCO site: On-line database and photogrammetry***

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### **ABSTRACT**

*Butrint, the ancient name for Buthrotum, used to be an important harbor between the Hellenistic and the Ottoman eras, and has been the first UNESCO World Heritage Site in Albania since 1972. It is located in the south-western region of modern Albania, an area which used to be part of the Roman province known as Epirus Vetus.*

*Butrint was excavated and discovered for the first time by the Italian archaeological mission directed by L. Ugolini (1928-1936) and subsequently investigated by the Archaeological Institute of Tirana (1960-1989) and by the Butrint Foundation (1995-2010). These archaeological campaigns brought to light a number of public and private buildings which still preserve floor decorations manufactured by highly skilled practitioners.*

*In order to better identify the floor decorations discovered in Butrint as well as their peculiarities and their space-temporal distribution, both buildings and mosaics have been catalogued and described in an on-line database called “TESS”. This census has allowed for the examination of the state of preservation of both architectural structures and mosaic decorations. Thanks to this census it was also possible to begin some consolidation and photogrammetry campaigns of the Butrint mosaics. This research method, which in the first place consisted in the collection of data, in their organization through an on-line database and eventually in a conservation and photogrammetry campaign, is an advanced methodology which in Albania was experimented within the Butrint site for the first time.*

### **1. BUTRINT PROJECT: 200 YEARS RESEARCH**

*Buthrotum*, with its strategic geographic position, situated at south-west of modern Albania, on the Straits of Corfu, in antiquity was part of the Roman province *Epirus Vetus*. From Hellenistic era to the end of Ottoman period Butrint was an important port, crossroads of the economic traffic in Adriatic and in Mediterranean sea. According to the tradition, the city was founded by some Trojan peoples, exiles from their city in flames, which took refuge in this small peninsula where they reorganized their own lives. According to Virgil, the city hosted Enea during his travel: “*We had soon put the could-capped citadels of Phaeacia / down below the horizon and we coasted along Epirus / until we entered the harbour of Chaonia and then / walked up to the lofty city of Buthrotum*” (Virgil. *Aeneid* III 291-3). Today Butrint is one of the most important archaeological sites of Albania and is the first Albanian site declared World Heritage Site by UNESCO (fig. 1).

The interest for this centre started in 1435 and in 1448, when Cyriacus d’Ancona, during his travel through Albania, visited Butrint and observed the ancient remains, describing them for the first time in the volumes *Commentarii*. Afterwards, in 1805, William Martin Leake visited and described this area in his volume “*Travel in Northern Greece*”, published in London in 1835 (MYRTO 1998, 56-59; CEKA 2005, 9-23; HODGES 2006, 25-34; 2007, 88). Some years later an Italian mission, directed by the archaeologist Luigi Maria Ugolini from Bologna University, undertook the first real excavation fields, which brought to light many “fragments” of the site’s life,

highlighting the settlement continuity from the Archaic age to the end of the Venetian period (UGOLINI, 1937).

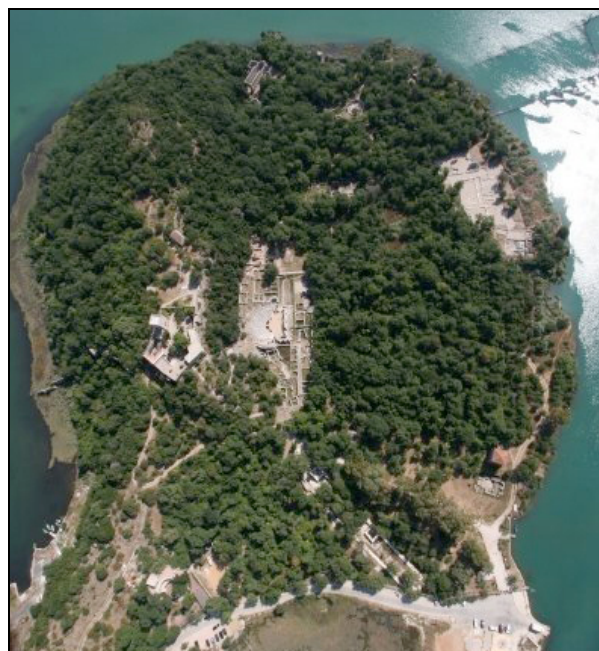


Figure 1. Aerial view of Butrint UNESCO site (Butrint Foundation).

After World War II, the excavation fields restarted in 1956: following up Nikita Khrushchev’s visit, general secretary of Communist Party of URSS, the Albanian archaeologist Dhimosten Budina coordinated the further research enlarging Ugolini’s investigation. This phase of

works in Butrint lasted for about forty years, during which the team was digging in the main Agora area, on the Acropolis and just sporadically somewhere else. The excavations reports are published, mainly in a summarizing way, in the archaeological Albanian review “Iliria”.

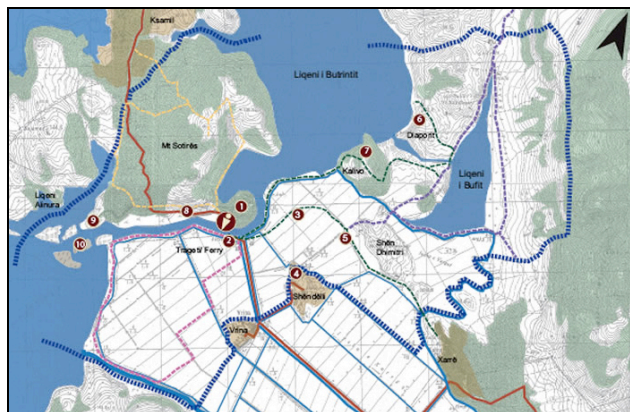


Figure 2. Marked walks in the Butrint National Park: 1 Butrint; 3 Vrina; 6 Diaporit (plane by Butrint Foundation).

The archaeological research started again in 1994 and currently goes on thanks to the cooperation between Butrint Foundation and the Archaeological Park of Butrint, which go on with the excavations not limited only to the centre of Butrint, but bordering their action radius on the neighbouring area, in Vrina Plane and Diaporit (fig. 2). The research brought to light new public and private buildings decorated with mosaics, which offered not only valuable comparisons, but also new interpretations for the comprehension of the life and the culture inside and outside of the walls of the city from Roman to Late Antiquity Age.

It must also be said that the excavations fields of Butrint Foundation have a further aim: the training of students, the future archaeologists and conservators of Albania, with scientific state of the art of methodologies (fig. 3).



Figure 3. Conservation training of students during the restauration of a mosaic in Vrina Plane (photo by Jack Neguer).

For this reason, during the excavation missions, spans of time are scheduled for training about excavation and restoration with teams of experts, in order to update students with new techniques and methodologies for mosaic restoration.

Therefore, this paper will present the methodology of the work undertaken, taking into account the twofold soul, didactic and scientific, and following the words of Jacques Neguer, from the Israel Antiquities Authority: “*The excavation provides a good opportunity for training and short team courses can be given during the excavation season. One part of the Albanian students can be involved in conservation works. The students in archaeology should have basic knowledge in conservation. The other way is to set up a long team conservation project at Butrint and in the frame of this project to provide the necessary training for the Albanian conservation, site rangers and custodians. The site can be the future education center for the whole country and in the summer to expand internationally with short team courses for students and archaeologists*” (NEGUER 2006, 35).

The new technology applications to the study and the conservation of the archaeological evidence represent one of the guideline of “Butrint Project”. The proposal innovation consists of integrating the informative effectiveness both of on-line databases and photogrammetry documentation, with the potentiality scientific and communicative of the virtual reconstruction conducted with philological criteria, finalized not only to the research, but also to the site fruition.

What is presented in the following pages is the fruit of the cooperation among the Butrint Foundation, the Archaeological Park of Butrint, the Archaeological Institute and the Culture Monuments in Tirana, Israel Antiquities Authority and Archaeology Department of University of Padua. As you can see from the list of participants, the energies spent on the field have been conspicuous, as well as time-consuming: five years of work to reach the expected results that speak of vast knowledge, conservation and valorisation of mosaics.

## 2. TESS PROJECT

Today, in the internet era, all is computerized and visible on line, almost everything is catalogued and usable by everybody, other than be in constant updating.

Also archaeology is moving in this direction: digitized researches and sometimes, where possible, rebuilt in 3D rooms, buildings, cities and landscape existed in past ages, founded on scientific data provided by archaeological excavation. This is possible thanks to new software which is always in evolution and thanks to national and international workshops in which the researchers present their projects and the results obtained, exchange ideas and compare their own experiences.

In this point of view, for ten years, a team from the Archaeological Department of University of Padua, coordinated by Prof. Elena Francesca Ghedini, has devoted special attention to the prospective of informatics applied to archaeology and to the valorisation of the archaeological findings as a method of work and study helpful to research. For the study, the conservation and the heritage of the mosaics an on-line database called “TESS” (in FileMaker Pro 9) was built. This database was conceived as a hierarchical structure which allows for the insertion of data entries about the finds. Their analysis starts from the general level and moves on to a more specific level and from the external to the internal level. This way of



conceiving the database starts from the description of the building and moves on to that of the room, followed by the floor decorations and eventually to an exhaustive presentation of the models that compose the mosaic. This system of study, based upon an organization of the information in different levels or strata, also introduces innovation in this type of research, since it highlights the architectural contexts which contain the floor decorations (GHEDINI et al. 2007; OMARI 2009; OMARI forthcoming). At the first level of the data entry field a page called “building” appears, which is about the location of the structure (Country, District, City, Village and address) and the typological description of the architectural context (e.g. private, public, thermal bath, temple, basilica). On this page, the map of the area can be linked in the field called “map building place”, thanks to a direct link to Google maps. Also the drawing of the building, if available, can be inserted into the “building plan” field (fig. 4).

At the same level, on a second page called “room”, the information about a decorated room can be inserted, starting from the description of the typology of room (peristyle, representative room, triclinium, pronaos, naos, aula, thermal room, tepidarium, narthex, nave, etc.), followed by its measures and description. Also here, like on the page before, a part of the slide is devoted to the on-line publication of the plan of the room. It must be pointed out that at the bottom of both pages, the one about the building and the one about the room, there is a field labelled “chronology” which allows for the insertion of the dating with the archaeological criterion adopted by the archaeologist for its definition (archaeological, stylistic-archaeological, etc.). In this way the first chronological reference is established which will be resumed on the page about the textures of the decorations, and which is useful to trace and compare the various phases of use of the structure and of the decorations they contain. At the second level, the two pages “covering floor” and “texture decoration” are devoted to the description of the cover floor which decorates the pavement (fig. 5).

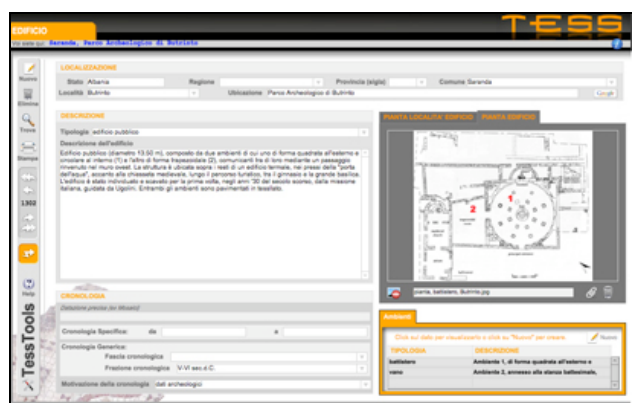


Figure 4: Database TESS-building slide.

On the “covering” page it is possible to be specific about the texture of the decorations of the floors. They can be with single cover or with multiple covers, that is, the floors can feature a single decoration or multiple decorations. The description of all pavement surfaces, general and synthetic, is accompanied by the images of the floor decoration, which is useful not only to better understand the decoration, but also to provide a complete overview. This page is the last one but not in terms of importance. On this page we find information about how to install the

mosaic and about how to conduct the laboratory analyses of the materials used to build the pavement. Besides the information described above, in the field devoted to the “covering” it is possible to give a more complete and updated overview of the floor decoration. Inside this field there is a field devoted to the inscription which allows for the insertion of the transcription, the translation, the measures, the language (Greek or Latin) of the inscription or the monogram/Christogram present on the cover floor.

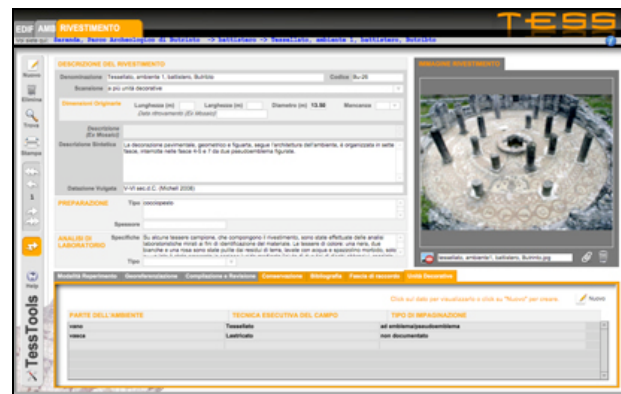


Figure 5: Database TESS-floor decoration slide.

On the following page, which is devoted to the texture of the mosaic surface, the decoration can be described in detail by means of specific terms. Here every component which forms the floor decoration is dismembered, in order to single out its basis pattern. Starting from the external to the internal part of floor decoration we will distinguish: the band connection, that is, the most external part in the mosaic which fills the gap between the borders of the mosaic and the walls when the measure of the room are not regular; the border, which limits both the field and the possible panels or the emblem/pseudo-emblem which makes up the cover floor; the field which corresponds to the mosaic without the border. The breakdown of the parts which make up the cover floor does not only allow for a detailed description of each decorative component and for the specification of the single motives used for the borders and the fields. It also gives one the opportunity to understand which patterns are required the most by local purchasers. In order to identify which of the geometrical patterns are used in the mosaics decorations, the chosen parameters of reference are those established by the volumes “*Décor géométrique*” edited by the French School (BALMELE et al 1985; BALMELE et al 2002). In order to better manage the quantity of information, the database is supported by three external archives which are connected to the computer system. These three archives make reference to the bibliography, the “*Décor géométrique*” pattern and to the conservation areas. To sum it up, we can say that the research is based on a collection in a database of all the information about the cover floor. It brings together the terminology and makes it possible to create typological grids for the identification of the related texture, decorations, colours, as well as the characterization of the type of the floor. After the critical analysis of the data, these elements briefly explain the specific taste of the people in the investigated area. The data collection of the mosaics found in Butrint shows that to date eighteen mosaics have been discovered, which decorated rooms of private and public buildings,

predominantly in three colours and with many colours with geometrical and geometrical-figurative patterns. The Butrint mosaics belong to a chronologic range from the 2nd century to the 6th century A.D. (OMARI 2009; OMARI forthcoming).

### 3. PHOTOGRAMMETRY APPLICATIONS ON THE MOSAICS OF BUTRINT

In Butrint, for the first time in Albania, the planning activities also favoured the technological transference of the most advanced studies in this sector of Cultural Heritage fruition, related to 3D Graphic, Virtual Reality, GIS, Semantic Web, etc.

For documenting and better preserving what was excavated before the last researches took place, the Butrint Foundation in cooperation with Massimo Zanfini from the Bologna University, has begun a rash of photogrammetric fields carried over on some mosaic floors and to be more precise on the mosaics of Triconch palace, on Baptistry mosaics, on mosaics found in Vrina Plave basilica and villa since 2005. To date twelve mosaics are documented by photogrammetry relief.

The methodology of photogrammetric documentation is carried out in the following steps in a precise hierarchy:

➤ The first step to do when undertaking a photogrammetric campaign consists of a meticulous **cleaning of the mosaic surfaces** (fig. 6), followed by careful **examination of the area of interest**; this procedure will allow selecting –with full knowledge of the facts– whether taking photographs from a low-flying kite and/or making the photogrammetry by a camera positioned on top of a pole around two meters high.



Figure 6. The cleaning of the mosaic floor (photo by Butrint Foundation).

➤ Once the state of preservation of the mosaic and the best conditions for taking the photogrammetry have been decided, points on the mosaic are chosen and then **recognized** through the total station. It is important that these points are visible in the picture; indeed thanks to these points the assembling of the pictures will be evident on the computer for recomposing the full mosaic decoration in detail.

The network positioning ensures with greater security that at least four points are present in each picture. The points need to be recorded by total station and brought together

with an increasing number; this procedure is necessary for creating a network which will build the archives of the points and of the images (fig. 7).

➤ For realizing the **photographic campaign** a simple digital camera is used, which is guided by remote control with infrared; the camera is fixed on top of a steel stick, around 2.5 metres long (fig. 8).

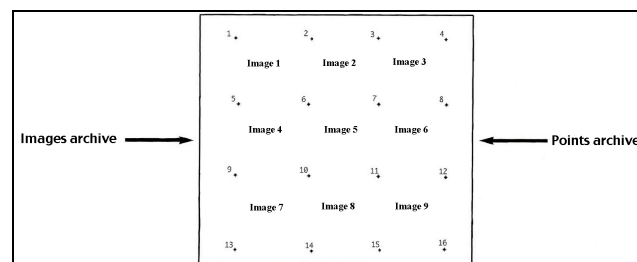


Figure 7. The grid points of the archives made during the photography (Zanfini 2003, 261, fig.1, revised by E. Omari).

Following the way of the sun, particular attention must be paid to the moment when pictures need to be taken in order to avoid the shadow zone as much as possible, since the natural conditions of the sun light are, obviously, the best ones. In order to show the colours of the tesserae in a more faithful way, before taking the picture, the part of mosaic selected for the picture is washed up with a water pump or with a simple sponge. At the same time each picture is checked in order to ensure that in every picture at least four points are present. Each picture is attributed with a number or an identification code which will be transferred into the network of points. This work leads us to the creation of two archives: one for the pictures and one for the points related to the picture (ZANFINI, VECCHIETTI 2004, 849-856).



Figure 8. Photogrammetry of the mosaic floor in Triconch Palace at Butrint (photo by Jacques Neguer).

➤ Once the pictures are obtained, they are processed following the process of **chromatic graduation**, **rectification** and **assemblage**, juxtaposing all the pictures following the network prepared in advance and reunifying



the chromatic graduated to assemble the different photos to one single image. All the work is done using the computer program Adobe Photoshop: in our case we used the version Adobe Photoshop 7.0. The goal is to create a plan photo in high definition, in which every single tessera is visible, to control the gaps of the mosaic, as well as to see the drawing in detail (fig. 9).

➤ A very important aspect of the fruition of archaeological data, at scientific and popular levels, is the **panoramic photography**. It consists of an “interactive” process, in which the user can scout the object (e.g. a mosaic, but also a room), by 360 degrees, moving the mouse. Thanks to the program QTVR (Quick Time Virtual Reality) it is also possible to activate zoom in and zoom out, for entering and seeing the artefact in detail. These files, available on the web, allow exploring the different rooms from a fixed position with a corner view of 360°, thus enabling the user to feel as he was in the middle of the building and immersed in it. (ZANFINI 2003, 259-266).

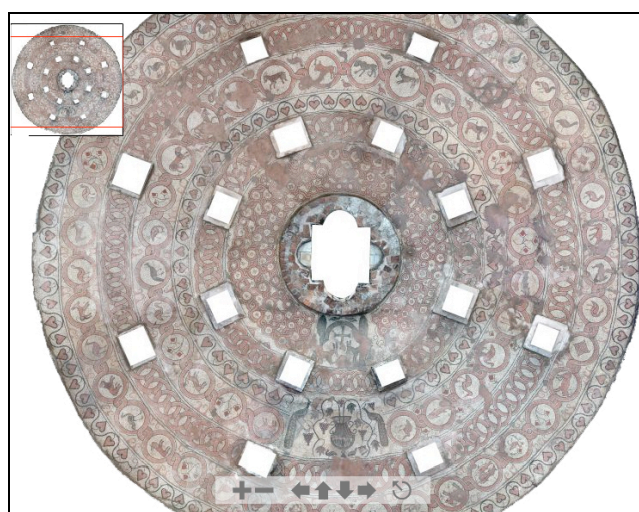


Figure 9. QTVR presentation of the mosaic floor of Baptistry ([http://www.butrint.org/explore\\_9\\_4.php](http://www.butrint.org/explore_9_4.php), made by Butrint Foundation).

In Butrint, a good example is the application of QTVR for the virtual exploration of the building of Baptistry, as well as for an exhaustive view of the mosaic decoration. Today it is possible to access these views on the website of Butrint. Such a work enhances the “virtual” presentation of the ancient building as it is preserved just as the mosaic which, supplied by a scientific text, will allow a correct and thorough limitless knowledge; by these means new international professional cooperation also can start examining the data.

At the same time using the above-mentioned programs some mosaics underwent also some restoration campaigns, which are still ongoing. The last restorations have brought the researchers to study the situation of the preparation levels of the mosaics and the consolidation of their damaged parts. Since these artworks are now situated in ancient buildings, not provided anymore with a ceiling, they are covered with sand and gravel in order to be protected from bad weather and corrosion of saltwater infiltrations from the Vivari Channel and Butrint Lake: a well-known problem to Ugolini, during his excavations period. (NEGUER 2006; 2007a; 2007b).

## 4. CONCLUSIONS

The data collection into the on-line database “TESS” and the study of the floor decorations in Butrint helped us to comprehend the topographic distribution of this ancient city, the taste of the area and the selections made by the purchasers about the decorative patterns to be represented in their mosaics, the abilities of the artisans to make the mosaics and the connections with the neighbouring areas. In the end of this paper, to sum up what was explored, it becomes clear that the scientific program followed in Butrint turns out to be an innovative program. For the first time, beside the archaeological excavations, the artwork – in our case the mosaics and the buildings which contain the decoration– are consolidated, catalogued in an on-line database, noted by photogrammetry rectification, valorised and publicized on-line.

As already mentioned, the “TESS” database allows the user in any time and from several points not only data entry and updating a considerable number of data and of information useful to the research, but also the consultation. In this way the database facilitates the data retrieval and therefore the study and the knowledge of the territory, of the building, of the floor decoration, of the material used and of the mosaic’s state of preservation.

The innovation proposed by the Butrint project consists in completing the informative validity of the photogrammetry documentation with the scientific potential and communicative power of the virtual reconstruction led with philological criteria, finalized not only to research, but also for gaining knowledge.

To conclude it must be said that the use of the new technologies represents a surplus value upon which one may aim for generating interest and curiosity among the visitors towards the cultural roots of the territory, in order to favour the circulation of the knowledge and to get benefit on the development of the territory. All this effort will be vain if these techniques and methodology were not communicated to the new generations by means of field training and application of this procedure also in other Albanian sites characterized by an archaeological and historical importance.

For the future we wish that the methodology shown here becomes a guideline for future archaeological researches in Albania, for their documentation in view of the heritage conservation and enhancement. (VOLPE 2008, 9-11).

## 5. REFERENCES

- BALMELLE C. et al 1985. *Le décor géométrique de la mosaïque romaine. Répertoire graphique et descriptif des compositions linéaires et isotropes*, vol. I, Picard, Paris.
- BALMELLE C. et al 2002. *Le décor géométrique de la mosaïque romaine. Répertoire graphique et descriptif des centrés*, vol. II, Picard, Paris.
- BRUMANA R. et al 2005, *Laser scanner integrated by photogrammetry for reverse engineering to support architectural site and restauration of the mosaic floor inside St. Mark’s basilica in Venice*, CIPA 2005 XX International Symposium (Torino, 26 september – 1 october 2005),

CATTANI M. 2008, *Il percorso della conoscenza: applicazioni in archeologia tra ricerca e divulgazione*, Informatica e il metodo della stratigrafia, Atti del Workshop (Foggia, 6-7 giugno 2008), a cura di G. De Felice, M.G. Sibilano, G. Volpe, Bari, pp. 25-37.

CEKA N. 2005, *Illirët*, Tirana, 9-23.

CLEMENTI T. 2004, *I mosaici come fonte archeologica per lo studio dell'urbanistica. Il caso di Padova*, Atti del IX Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico (Aosta, 20-22 febbraio 2003) a cura di C. Angelelli, Ravenna, pp. 139-150.

DE FELICE G. 2008, *Il progetto Itinera. Ricerca e comunicazione attraverso nuovi metodi di documentazione archeologica*, Informatica e il metodo della stratigrafia, Atti del Workshop (Foggia, 6-7 giugno 2008), a cura di G. De Felice, M.G. Sibilano, G. Volpe, Bari, pp. 13-24.

GHEDINI E. et al 2007, *La banca dati on-line dei rivestimenti a mosaico*, Archeologia e Calcolatori, 18, pp. 13-43.

HODGES R. 2006, *Eternal Butrint. A Unesco World Heritage Site in Albania*, London, General Penne Publishing.

HODGES R. 2007, *Novità archeologiche da Butrinto. Duecento anni di ricerche a Butrinto, Paradigmi che cambiano*, Groma 1. Archeologia tra Piceno, Dalmazia ed Epiro, Bologna.

HODGES R., BOWDEN W., LAKO K. 2004, *Byzantine Butrint. Excavations and Surveys 1994-1999*, Oxford, Oxbow Books.

MITCHELL J. 2008, *The Butrint baptistery and its mosaics*, London-Tirana, Butrint Foundation.

MYRTO H. 1998, *Buthroton*, Albania archeologica. Bibliografia sistematica dei centri antichi, Bari, 50-60.

NEGUER J. 2006, *Conservation of mosaics at Butrint, Albania, Final report and recommendations*, Butrint Foundation and Israel Antiquities Authority Arcaivs, July 2006, (unpublished).

NEGUER J. 2007a, *Conservation of mosaics at Butrint, Albania, Final report and recommendations*, Butrint Foundation and Israel Antiquities Authority Arcaivs, July 2007, (unpublished).

NEGUER J. 2007b, *Conservation of mosaics at Butrint, Albania, The triconch domus. Condition report and recommendations*, Butrint Foundation and Israel Antiquities Authority Arcaivs, December 2007, (unpublished).

OMARI E. 2009, *Storia e sviluppo dei rivestimenti pavimentali nell'area sudoccidentale dei Balcani. L'Albania (fine del IV /inizio del III sec.a.C.-VI sec.d.C.)*, PhD dissertation, University of Padua, Padova, (unpublished).

PIETRONI E. 2008, *Ambienti collaborativi ed ecosistemi virtuali per la trasmissione e comunicazione del patrimonio culturale: il museo virtuale della via Flaminia antica*, Informatica e il metodo della stratigrafia, Atti del Workshop (Foggia, 6-7 giugno 2008), a cura di G. De Felice, M.G. Sibilano, G. Volpe, Bari, pp. 55-73.

VOLPE G. 2008, *"Pesare la digitalizzazione". L'informatica applicata all'archeologia tra tecnologia e metodologia*, Informatica e il metodo della stratigrafia, Atti del Workshop (Foggia, 6-7 giugno 2008), a cura di G. De Felice, M.G. Sibilano, G. Volpe, Bari, pp. 9-11.

ZANFINI M. 2003, *Il rilievo di un pavimento musivo sito di Bir Messaouda, Cartagine*, Ocnus. Quaderni della Scuola

di specializzazione in archeologia, nr. 11, Bologna, pp. 259-266.

ZANFINI M., VECCHIETTI E. 2004, *Fotogrammetria e virtual reality. La casa del Centenario (IX, 8, 3.6.A) a Pompei*, Atti del IX Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico (Aosta, 20-22 febbraio 2003) a cura di C. Angelelli, Ravenna, pp. 849-856.

UGOLINI, L. M. 1937, *Butrinto. Il mito di Enea, gli scavi*, Istituto Italiano di Cultura, Tirana.

*Ut natura ars. Virtual Reality e archeologia*, Atti della Giornata di Studi (Bologna, 22 aprile 2002), a cura di A. Coralini, D. Scagliarini Corlàita, Imola.

## 6. WEBSITES

<http://www.butrintfoundation.co.uk/>

<http://www.butrint.org/>

<http://www.perseo lettere.unipd.it/tess/>

<http://www.antiquities.org.il/>

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