HISTORICAL DOCUMENTATION AND DIGITAL SURVEY FOR THE REPRESENTATION OF THE PORT LANDSCAPE

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ABSTRACT:

The paper proposes a survey of the port of Fiskardo, a village located north of the island of Kefalonia, the largest of the Ionian Islands, in Greece. Called the “Venice of the South” as the coloured elevations of the houses, the subject of the research, are similar to Venetian buildings, Fiskardo owes its name to Roberto d'Altavilla who founded a Frankish colony in this bay.
The study, starting with archival iconographic research, was carried out with the support of the photogrammetric technique supported by a four-helix drone allowed the documentation of the cultural heritage. This activity is configured as a search for identity characteristics through actions of knowledge of the places and geometries of the port through the use of UAV technologies.

1. INTRODUCTION

The research presents the results of the study conducted in the summer of 2021 with instrumental drone survey campaigns and related comparison of historical and iconographic sources.
As a case study, the structures in the port of the village of Fiskardo are analysed, with particular reference to the urban sea-facing fifth.

The study conducted starts from the documentation available in historical archives where the group of islands is usually referred to as the Eptianeso, 'the seven islands', since it includes several other smaller islands in addition to the seven larger ones. There are no particular previous studies on the subject and, therefore, the research is unpublished both in terms of graphic comparisons and digital surveys.

An analysis of the few historical documents found, such as Portolans, paintings, nautical charts, and travellers' notebooks, shows that they have been inhabited since 1800, from the time the islands acquired geographical unity through the Western European independence achieved from 1204, when at the end of the Fourth Crusade, they became a dependency of the Venetian Republic. The Kingdom of Greece, created as a result of the Greek uprising against the Turks that broke out in 1821, only had its current political-geographical borders defined after the Second World War, when Italy's custody of the twelve islands in the eastern Aegean was terminated.

In this historical political background, there were few sources for writings as well as for graphic and topographical maps.
The survey, marked as a graphic technique for knowledge and documentation of the places, made use of drone technology, the only method capable of documenting the current state of the places in the presence of large crowds of tourists. In fact, the research was conducted in August 2021 in the presence of tourists, bathers and numerous boats entering and leaving the port.

This tool allowed a rapid geometric-configurative view of the port structures currently serving a tourist function. The activity of surveying the port from a drone is configured as a graphic unicum both for the techniques used, specific to the discipline of drawing, and for the documentary analysis of the few sources found and compared.

The drone used, which was small in size, facilitated filming even with a large number of tourists residing in the many port buildings and crowding the boats in motion. The images taken were subjected to the photogrammetric post-production stages to arrive at digital models of knowledge of the places.

Figure 1. Fiskardo Port, drone photo, northern view.

Figure 2. Fiskardo Port, drone photo, southern view.

Figure 3. Fiskardo Port, drone photo, bird's eye view, northern view.

Figure 4. Fiskardo Port, drone photo, bird's eye view, southern view.

2. HISTORICAL EVENTS AND PRESENT POSITIONS

An analysis of the archive and bibliographical sources has shown that the Ionian Sea, an important communication route, is the deepest basin of the Mediterranean and has importance above all as a transit sea, even though in antiquity it designated that stretch of coastline separating then Illyria from Italy. (Rizakis, 1996)

The islands, due to their geopolitical position as a crossroads between East and West, were used as territories to administer and manage important military, cultural and economic exchanges. In the earliest period of archaic Greece, the governors of the cities of Euboea and Corinth decided to establish colonies and resting places on the islands and coasts of mainland Greece, while centuries later, along the same geographical axis, colonies of the emperors Caesar and Augustus were founded on the coast of the western Balkans. (Angelier, Lyberis, Le Pichon, Barrier, Huchon, 1982)

With the subsequent Roman conquest came a long period of peace and economic development. With the division of the empire, the islands were assigned to the Eastern Kingdom and fell under Byzantine rule, which had not fully established itself, partly due to the invasions of barbarian peoples, particularly the Ostrogoths. In the 10th Century, the islands repulsed a Slavic invasion, while two Centuries later, especially in the south, the Normans, who planned to conquer Byzantium itself, settled there. New coastal settlements were founded along the channel between Kefalonia and Ithaca, at Kateleios, Hagia Euphemia and Fiskardo. (Isambert, 1881)

The site of Fiskardo, north of the island of Kefalonia not far from Ithaca, is a Roman settlement, closely related to Nikopolis, a city of ancient Epirus.

Figure 5. Arrowsmith, Aaron Jr., Southern Greece, with the adjacent Islands, London, 1828. Cartography of Greece.

Figure 6. Arrowsmith, Aaron Jr., Southern Greece, with the adjacent Islands, London, 1828. Detail of the cartography with the island of Fiskardo highlighted in red.

Figure 7. B. Bordone, Isolario di Benedetto Bordone nel qual si ragiona di tutte l'isole del mondo [...], Veneto, 1534.

Identified with the ancient city of Panormos, mentioned in literary sources by the Greek historian Herodotus in the 5th Century BC, it has public buildings, baths, a small theatre and a large cemetery. The village of Fiskardo owes its name to Robert of Altavilla, known as Guiscard, a Norman leader and Duke of Apulia and Calabria, who fought with his brother Roger I of Sicily against the Byzantine Greeks in Italy.

The Norman adventurer occupied the island in 1081, but the Byzantines, with the help of the Venetians, recaptured it at the Battle of Butrint in 1085. Only a year later, he died of the plague. Today, the town is referred to as the “Venice of the South” as the colourful elevations of the houses are Venetian-style and are painted in pastel colours.

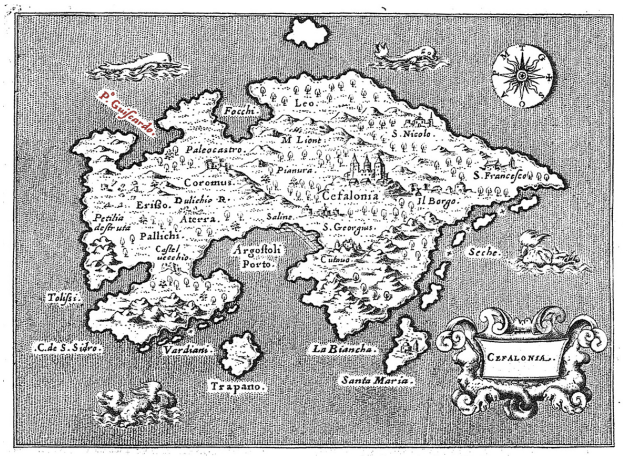

Figure 8. T. Porcacchi, L'isole più famose del mondo, Heredi di Simon Galignani, Venice, 1590, p. 121.

3. THE SURVEY PHASES

In order to understand the formal and graphic aspects of the village of Fiskardo, the survey was conducted by an indirect method, using the photogrammetric technique supported by a digital camera and a four-powered drone.

The instrumentation made it possible to fly the structures of the harbour located in the northernmost part of the island in order to create a series of images of the village's urban fifth. As is well known, photogrammetry extracts metric information from the evaluation of fixed elements on the scene of the image taken by the operator for research purposes.

This method, developed since the mid-19th Century, is widely used in various fields, from the cartographic survey, carried out with aerial photogrammetry, to the architectural survey subject of the research and implemented following established procedures and related post-production phases.

The latter allows the survey to be carried out with a field of view from both close-up and from medium and long distances. Characteristics of the photogrammetric technique are the graphic capacity to not be influenced by the geometric characteristics and obstacles of the materials and the surface alterations of the object, the low cost and the ease of high-resolution acquisition through a digital drone camera.

The UAV technologies represent a significant innovation as they are used to speed up survey work, but also as an assist in producing three-dimensional models of architectural, urban and landscape heritage. They are flexible, increasingly accessible and constantly improving in terms of performance, range and quality of mounted sensors. (Calantropio, Chiabrando, Einaudi, Teppati, 2019)

These digital technologies offer the possibility of obtaining specific results not only from surveying activities, but also in representation and visualisation, with the effect of obtaining an accurate metric description of the territory, structures and buildings. (Eisenbeiss, 2004)

In the Fiskardo case study, using UAV instrumentation, various photographic shots were taken at different heights. The method used is that of following a grid: in order to properly reconstruct the point cloud, frames are acquired in sequence, matching and overlapping the first photo to the next with a percentage of no less than 70%, and then starting a processing process that led to the creation of a georeferenced point cloud and an orthophoto of the area of interest.

Figure 9. Fiskardo Port, cloud of sparse dots.

Figure 10. Fiskardo Port, dense cloud of dots.

Figure 11. Fiskardo Port, dense point cloud with identification of the chambers.

Figure 12. Fiskardo Port, dense point cloud, southern view.

Figure 13. Fiskardo Port, dense point cloud, northern view.

Figure 14. Fiskardo Port, dense point cloud, view from the dock.

Figure 15. Fiskardo Port, dense point cloud, view from the dock.

Figure 16. Fiskardo Port, dense point cloud, as seen from the dock.

Figure 17. Fiskardo Port, dense point cloud, as seen from the dock.

Figure 18. Fiskardo Port, tessellated model (tiles).

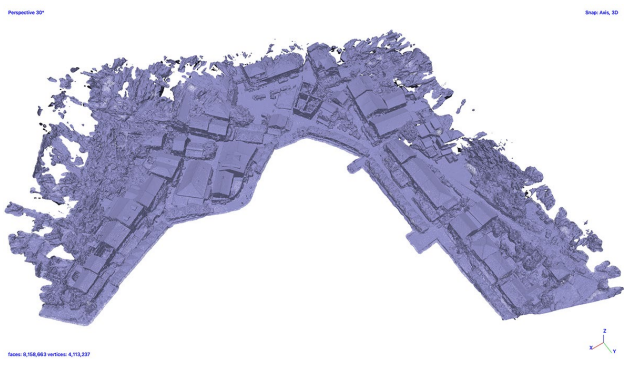

Figure 19. Fiskardo Port, 3D solid model.

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Figure 20. Fiskardo Port, shaded model.

Figure 21. Fiskardo Port, orthomosaic.

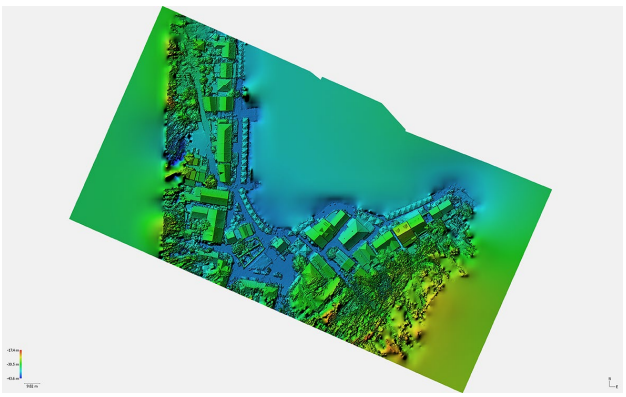

Figure 22. Fiskardo Port, digital elevation-morphology model (dem).

These drone surveys resulted in point clouds, digital views with metric, geographic and colorimetric information, as well as composing an initial basis for the graphic documentation of the site. (Gerke, 2018)

Of great importance in surveying activities, in addition to the time advantage, is the large amount of data that these instruments are able to capture. The models created with are very close to a continuous model, in which the interdistance between points, when compared to the size of the surveyed object, is of considerable precision. Using meshes, surface models of the surveyed object were constructed, which were textured with the images taken during the survey. (Vidalis-Kelagiannis, Kalogeropoulos, Grigorakakis, Stathopoulos, Petropoulos, Tsatsaris, Chalkias, 2021)

This activity provided, for the case study, a three-dimensional model with textures, with the colour characteristics of the building and the natural and marine system of the surrounding harbour. It was possible to extract, the contour lines that govern the elevations of the hill behind and the different elevation changes that characterise the port.

In the data processing activities, the technical feature of the programme provided the possibility to interpolate geometric data with photographic images in order to create textured digital models. The digital elevation model (DEM) derived from the data fusion was constructed in geographic, planar projection. The procedure, from the acquisition of the photographic material to the generation of the 3D model, consisted of four stages: alignment, construction of the dense cloud of points, construction of the mesh, and orthophoto generation. (Remondino, Rizzi, Agugiaro, Jimenez, Menna, Baratti, 2011)

The final result shows how complex surfaces, such as those characteristics of the Fiskardo village, can be derived from drone images and digital models can be generated for site knowledge.

Figure 23. Fiskardo Port, OpenStreetMap.

4. CONCLUSIONS

The documents produced highlight the importance of interpolating historical data, graphic and iconographic sources, and the writings of travellers who ploughed the territories, with the possibility of geometrically verifying the structures in the port of Fiskardo.

With the help of a UAV instrumentation system, it was possible to survey places and heritages that are not always known and often only used or to welcome tourists and the curious passing through the island.

The contribution demonstrates how the adoption of aerial survey methodologies and photogrammetric restitution provide an interesting archive for documenting the territory and buildings.

The images obtained highlight the geometric characteristics of places with particular reference to areas subject to particular constraints, such as port areas.

In addition to the documentation phases, the study presents itself as the basis for the subsequent analysis and use of spaces for material, seismic and lighting studies. (Banfi, 2017)

The graphic elaborations realised present such characteristics as to allow an interdisciplinary approach for the use and protection of port spaces.

REFERENCES

Angelier J., Lyberis N., Le Pichon X., Barrier E., Huchon P., 1982. The tectonic development of the Hellenic arc and the Sea of Crete: a synthesis. In Tectonophysics, 86, Issues 1–3,1982 pp.159-196.

Banfi F., 2017. Bim Orientation: Grades of Generation and Information for Different Type Of Analysis And Management Process. International Archives of The Photogrammetry, Remote Sensing & Spatial Information Sciences, 42, 2017.

Calantropio A., Chiabrando F., Einaudi D., Teppati Losè L., 2019. 360° images for uav multisensor data fusion: First tests and results. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives Vol. XLII-2/W13, pp. 227–234.

Eisenbeiss H., 2004. A Mini Unmanned Aerial Vehicle (Uav): System Overview and Image Acquisition. International Archives of Photogrammetry. Remote Sensing and Spatial Information Sciences, 36.5/ w1, 2014, pp. 1-7.

Gerke M., 2018. Developments in UAV-Photogrammetry. In Journal of Digital Landscape Architecture, 3, 2018, pp. 262-272.

Isambert É., 1881. Itinéraire descriptif, historique et archéologique de l'Orient. Paris, Librairie Hachette Et C., Boulevard Saint- Germain,79.

Micieli M., 2019. Aerofotogrammetria con i droni. Mappatura e modellazione 3D del territorio con tecniche aerofotogrammetriche da UAV (Sistemi Aeromobili a Pilotaggio Remoto). Palermo: Dario Flaccovio.

Remondino F., Rizzi A., Agugiaro G., Jimenez B., Menna F.N., Baratti G., 2011. Rilievi e Modellazione 3D, in “Atti 15° Conferenza Nazionale ASITA”, Reggia di Colorno, 2011, pp. 1825-1836.

Rizakis, A.D., 1996. Les colonies romaines des côtes occidentales grecques. Population et territoire. In Dialogues d'histoire ancienne, 22, n°1, 1996, pp. 255-324.

Souyoudzoglou-Haywood C., 1999. The Ionian Islands in the Bronze Age and early Iron Age, 3000-800 BC, Liverpool University Press,1999, ISBN 0853236542

Vasiliev A. A., 1964. History of the Byzantine Empire, 324–1453, Second English Edition, Volumes II, University of Wisconsin Press, 1952. ISBN 9780299809232

Vidalis-Kelagiannis M., Kalogeropoulos K., Grigorakakis G., Stathopoulos N., Petropoulos G. P., Tsatsaris A., Chalkias C., 2021. GNSS and UAV in archeology: high-resolution mapping in Cephalonia Island, Greece. In GPS and GNSS Technology in Geosciences, Elsevier, 2021, pp.371-390, ISBN 9780128186176