The Settlement Pattern of Ancient Icaria through a GIS Approach
A PhD Project (preliminary report)

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Abstract. Icaria, an island located in the Eastern Aegean Sea, on the path from Cyclades to Asia Minor, has always been among important civilizations. Thus, the presence of human activity on the island during the entire Antiquity should be considered as a fact. However, until today, archeological finds on the island remain scant, for various reasons, in a way that the ancient environment can't be reconstructed. In addition to that, there are only a few literature sources mentioning information about the area.
Given the aforementioned facts, this PhD project deals with the reconstruction of ancient Icaria's settlement pattern, using GIS analyses and predictive modelling. The aim of this paper is to present the techniques (Digitization, GPS survey, Remote Sensing, Database construction), that have been used in producing the topographical background and the analyses that have been performed until now, in order to collect the data, which are needed for the predictive modeling.
Results from the predictive modeling are going to be tested by a surface survey, which is planned for this summer period. The final product of this PhD project can be used by the local archaeological service as a Cultural Heritage Management tool and may serve as a prototype in similar cases.
Keywords: Icaria, GIS analyses, Predictive Modelling, GPS, CRM

1. Introduction

1.1 Geographical Position of the Island

Icaria, a Greek island of the Eastern Aegean Sea, is located 143 nautical miles east of Piraeus and 10 nautical miles west of Samos (Fig.1). The island's shape is oblong, measuring 267 km2 in area, with a very stiff relief in many of its parts, leaving only a few small plains available for cultivation. Despite the fact that the habitants' main occupation is cattle-breeding, they have always been self-sufficient.
The island is divided by mount Atheras (1020m height) in two parts, the northern and the southern, and has very few anchorages. The northern part is covered by trees and is very rich in water resources, since it has many streams, which provide water throughout the year. The southern part is dry, with volcanic rocks, and has two of the most radioactive springs in the world. These springs have been exploited since the classical period as medicinal spas.

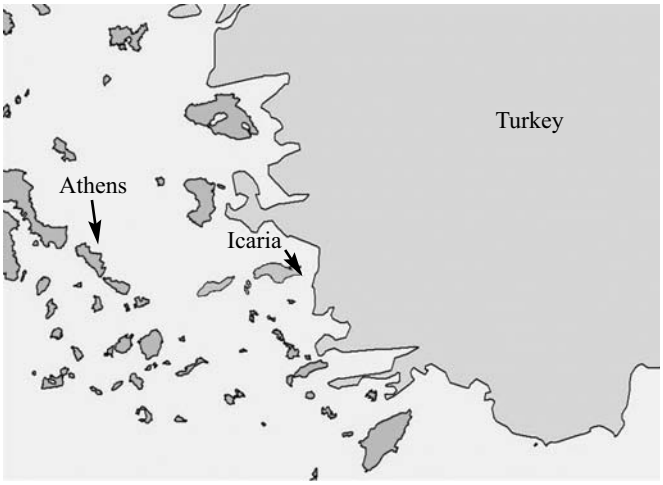

Fig. 1. Location of Icaria Island in the Eastern Aegean Sea.

1.2 History of the Island

Due to its geographical position, Icaria has always played its role in History. Being in the sea-way, which connected Athens with Delos and the Ionian coast (Miletus and Ephesus), it must have been settled since the prehistoric period, judging from finds in a number of caves on the island. In addition the myth of Icarus and Daedalus connects the island with the Minoans.
However, most of the finds are dated to the Classical-Roman period, while two cities are mentioned in scripts of that period, Oenoe and Thermae. Those cities were part of the Athenian League, paying a large amount of money for the common fund. Later, a third city, smaller in size and importance, appears in the northeastern cape of the island, Dracanon, right opposite to Samos and the Fournoi islets.
The island has been continuously settled until today, though it has never had a dense population due to the poor conditions of life. It's also worth mentioning that Icaria has been an exile-place, both in the Byzantine period so as during the period 1946–1952.

Archaeological Researches

The first archaeologist to contact excavations on the island was L. Politis, who excavated the site of Artemis Tavropolos temple at Nas in 1938–9 (Politis 1939a, 1939b). The temple (Fig. 2) is believed to be of great importance for the cult of Artemis and has produced a considerable amount of archaeological finds.

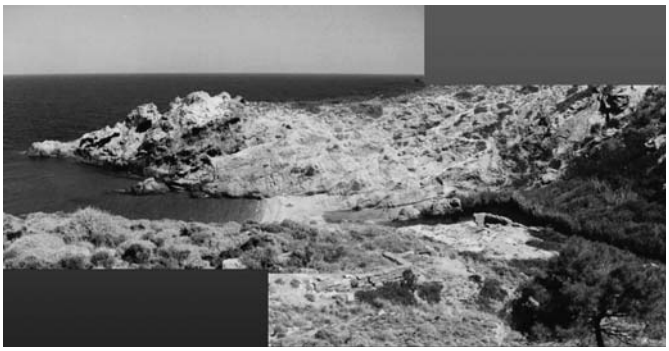

Fig. 2. The temple of Artemis Tavropolos at Nas. The remnants have been dated from the Mycenean to the Byzantine period.

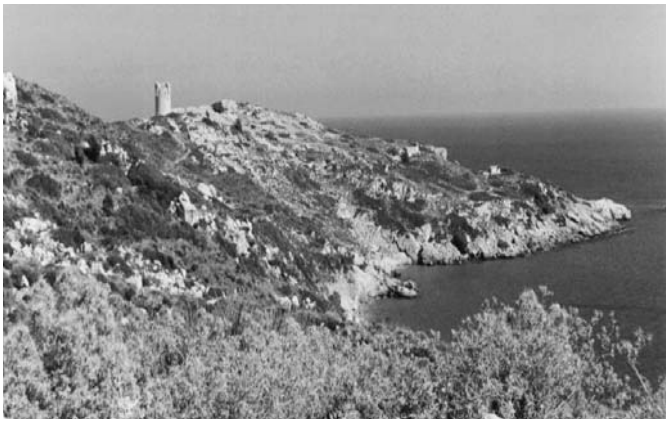

Fig. 3. The acropolis and the Hellenistic tower (arrow) at cape Dracanon. The site overlooks the sea passage between Samos, Icaria and Fournoi islets.

The rest of the researches until today have only been rescue excavations which have only uncovered part of the two cities of the island, Oenoe on the northern coast and Thermae on the southern coast. In addition, archeologists have uncovered a number of tombs, and two small fortified sites, at one of which, Dracanon, stands a 10-meter high Hellenistic tower (Fig 3).

2. Purpose of the Study – Methodology

Unfortunately the aforementioned data do not clarify the reconstruction of ancient Icaria's settlement pattern during Antiquity. Although there is significant evidence of habitation on the island since the prehistoric period, no systematic research on the settlement pattern has ever been contacted. In addition to that, there are only a few references about the island's history in the ancient literature and a poor bibliographic documentation of the finds of the rescue excavations. Since the reconstruction of ancient Icaria's settlement pattern is rather challenging, from the archaeological point of view, it has been decided to use Geographic Information Systems as a tool for this case study. Final aim of the project is to combine data from the GIS and Remote Sensing analyses with archaeological and social facts, in order to create a predictive model for unknown settlement sites. This model is going to be tested in the southwestern part of the island, which up to this date seems completely uninhabited.

2.1 Database Creation

A simple database, designed to work both individually and in consistency with the Geographical Information System, has been created in such a way that it can be used in the future by the local authorities and the Archaeological Service for the cultural heritage management of the island. The database contains information about the architectural remnants and the archaeological finds, photos and designs of them, relevant bibliography and GPS coordinates of the sites.
The design of the database, consisted of entities and relationships between them according to the E/R model, has been transformed into MS ACCESS tables. The final product can be converted to a double-leveled operating system in order to provide limited access to unauthorized users. First level access is limited to authorized users, who can either enter, update and delete data or perform predefined queries. After updating the different fields, data can be exported to the geographic database of the GIS. In a second level, access is allowed to all users, mainly for performing predefined queries and printing their results.
Up to this point, only entries about sites with published bibliography have been made.

2.2 GPS survey

After having completed the data entry for the known archaeological sites, a GPS survey was conducted in order to acquire their coordinates.
The mapping of the sites was carried out using 2 subcm geodetic GPS receivers (Ashtech Z-12 double frequency receivers) with a static differential mapping procedure (choke ring and 700718?_Geo.III L1/L2 antennas were used for the particular purpose).
Coordinates for 9 known archaeological sites have been recorded, either as single points or as polygons (4–5 points), depending on the preservation of each site. In addition, a number of GCPs have been acquired, in order to use them later in the georeferencing of the aerial and satellites images.

2.3 Geographical Information System

The specific Geographical Information System contains data in both vector and raster format. All data have been transformed in the same geodetic reference system, the Hellenic Geodetic Reference System 1987 (EGSA '87), which is used by the National Cadastre of Greece. The GIS can either be used singularly or in significance with the database.
Vectors. 40 topographical maps (37 scale 1:5000, 3 scale 1:50000)[1] and a geological map (scale 1:50000)[2] were digitized in order to create the digital background of the island (Fig. 4).
As a result, contours (elevation every 20m) and topographical points, the coastline, main and dust roads, streams and springs, caves, geological formations and geological faults have been digitally produced.

Rasters. The digital elevation model (Fig. 5) of the island has been created in TIN format, using the digitized contours and topographical points.

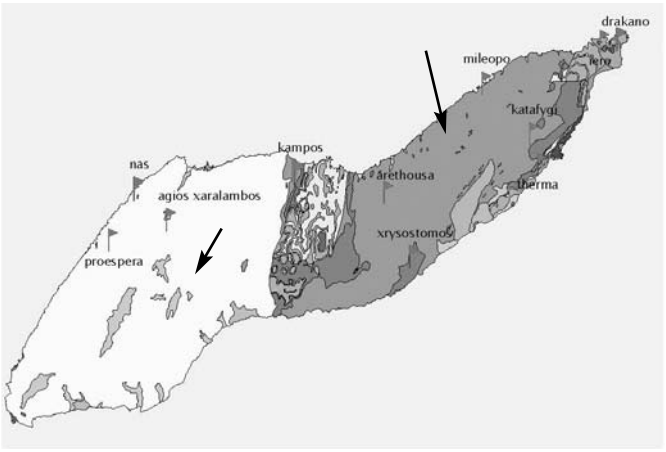

Fig. 4. Digital geological map of Icaria (the flags indicate known archaeological sites).

Site	Elevation (m)	Aspect	Slope (%)	Geology
Nas	33.25	N,NE,NW	0-31.9	W Icaria Granite
Proespera	360	Flat	0	W Icaria Granite
Oenoe	32.6	S, SE	18.9-22.3	Gneiss
Oenoe/Palatia	29.06	E	31.6-33.6	Gneiss
Ag, Charalambos	386.5	S	23.33-32.16	W Icaria Granite
Dracanon	31.75	NE	0-25.6	Schist - Marble
Katafygi	460	Flat	0	Schist - Marble
Thermae	40.30	S	34.7	Gneiss - Marble

Table 1. Results of Elevation, Aspect and Slope Analysis, combined with the Geological Features for known archaeological sites.

The coordinates of the known archaeological sites were superimposed on that, so that information regarding the elevation, slope and aspect of each site can be acquired.
Analyses. Since the project is still in initial stage, only a few of the GIS analyses (Aspect and Slope analysis) have been performed. The first preliminary results for the known archaeological sites, combined with the geological formations that apply to each of them, are shown in table 1.

3. Future plans

As mentioned above, this is a preliminary report of a project that will continue for the next two years.
Digitization of land use and land capability maps (scale 1:50000) is planned, in order to obtain more information regarding the cultivation capability of the island.
The topographical features, that have already been digitized, will be used in order to calculate the distance of the archaeological sites from the coastline, bays, streams, springs, geological faults, possible road passages and the distance between the sites themselves.
A number of aerial images will be bought as soon as a permission from the Army is obtained (as Icaria is located at Greece's borders, special laws apply to maps' and aerial images' acquisition). The aerial images will be georeferenced to the Hellenic Geodetic Reference System 1987 (EGSA '87) and then joined to a mosaic. The next step will be to recognize the spectral signatures of the archaeological sites.
All the abovementioned data will be combined to a predictive model in order to propose possible settlement sites.
The model will be tested by a surface survey in the south-western part of the island (Fig. 6), which until today has shown no sign of habitation.
The final product of this project, a digital operating system which will combine the database and the GIS and could easily be installed in user-friendly interface on the internet, can be used by the local authorities (municipalities and prefecture) and the Archaeological Service as a tool to protect and promote the Cultural Heritage of the island.

Notes

[1] Provided by the Hellenic Military Geographic Service.
[2] Provided by the Hellenic Institute of Geology and Mineral Exploration.

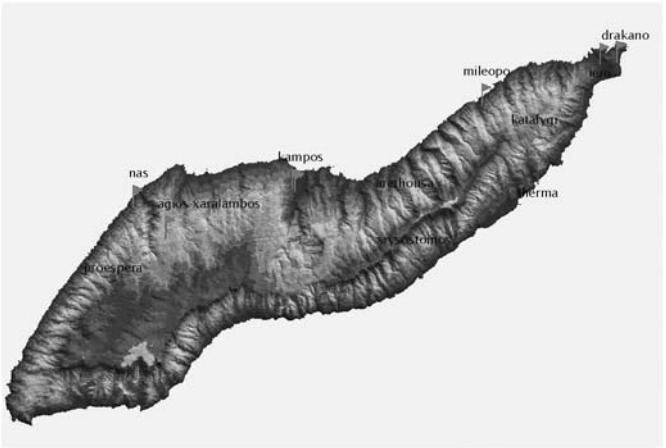

Fig. 5. Digital Elevation Model of Icaria in TIN format (the flags indicate known archaeological sites).

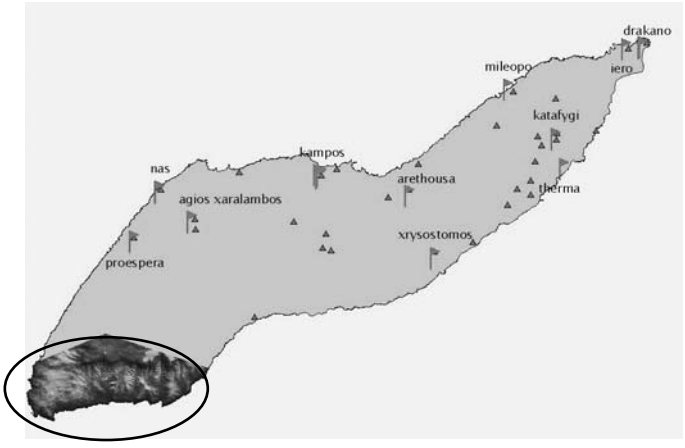

Fig. 6. Known archaeological sites (shown with flags), sites with random archeological finds (shown with triangles) and the surface survey area (in circle).

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