

Lake Mareotis Research Project

Introduction

Alexandria was one of the great cities of the Mediterranean. Since its foundation in 331 BC and for almost a millennium to follow, it was the political, economic and cultural capital of Egypt, and one of the most significant emporia and complex ports in the Hellenistic and Roman world. Much of the city's wealth and prosperity were generated by trade through its important and complex harbour system, which included, not only harbours on the sea, but also on Lake Mareotis to the south and west of the city (Fig. 1). Moreover, the shores of Lake Mareotis embraced major production centres for different industries such as glass, pottery and wine, which contributed significantly to the economy of Alexandria and of Egypt as a whole. To date however, Lake Mareotis has been a much-underrated resource particularly with respect to its economic relation to Graeco-Roman Alexandria. Moreover, many archaeological sites located along the shores are endangered by modern urban development and various industrial and agricultural activities. Therefore, since 2004 the Centre for Maritime Archaeology (CMA) of the University of Southampton, in collaboration with the Department of Underwater Antiquities (DUA) of the Egyptian Supreme Council of Antiquities (SCA), has been conducting a comprehensive archaeological survey along the shores of Lake Mareotis west of Alexandria.

The project aims to quantify the archaeological resource and address the nature of maritime and economic activities conducted around the western arm of the lake, particularly during the Graeco-Roman period, when Lake Mareotis is believed to have been most active. In doing so, the project is investigating substantial area of the lake's shores and seeking to relate the results of previous work undertaken throughout the lake by other archaeological teams, in order to produce a coherent overview of its activities. This in turn would redress the current imbalance in our knowledge of the Alexandria region, and provide scholars with much needed data by characterising the production and function of the lake and thus, the city it supported.

The project is directed by Dr. Lucy Blue (CMA) and Dr. Sameh Rames (DUA/SCA). Fieldwork for this project is funded by the British Academy, while funding for the project's postdoctoral researcher, Dr. Emad Khalil, was awarded by the Leverhulme Trust.

Lake Mareotis

Lake Mareotis, precursor of the present Maryut Lake, represented one of the most distinctive geomorphological features in the north-west coast of Egypt during the Holocene period. It was, and still is, quite unique compared to other lakes on the Egyptian north coast, which were formed as a result of the sea inundating the north coast of the Nile Delta. In antiquity Lake Mareotis was formed solely by the Nile, which fed the lake through a network of canals that branched off the river's defunct Canopic Branch, and approached the lake from the south and the east (Fig. 2). Moreover, it was connected to the sea at Alexandria through a navigable canal that debouched at the city's western harbour. Accordingly, besides being a fresh water lake, Mareotis also gave access to the Nile and hence to the whole of Egypt. Therefore, it is believed

that the location and characteristics of Lake Mareotis, gave the city of Alexandria one of its major advantages.

Historical, archaeological and geomorphological evidence indicate that Lake Mareotis consisted of two interlinked parts; the main basin of the lake, which extended for 40-50km south of Alexandria, and a narrow arm which was about 3km wide and extends west of Alexandria for about 40km. However, it is evident that Lake Mareotis has undergone dramatic changes during the past two millennia, which significantly affected its size and nature. During the 5th century AD, the Canopic Branch started silting up and it became defunct by the 12th century AD. Accordingly, Lake Mareotis lost its connection to the Nile, and the once navigable freshwater lake became a closed lagoon with no constant supply of water. Due to increasing evaporation, the size of the lagoon decreased significantly and by the end of the 18th century Mareotis was almost dry, except in the rainy seasons.

Lake Mareotis remained dry for almost 700 years until it was intentionally flooded with seawater twice in the early 19th century, as strategic actions, ending forever its life as a fresh water lake (Fig. 3.). However, once again, Lake Mareotis started drying up due to increasing evaporation until most of its basin became dry arable land. It was not until the early 20th century, when the major irrigation projects in the western Delta were established, that the depression started receiving agricultural runoff and irrigation water carried by a number of canals and drains, filling the depression and creating the present Maryut Lake.

At present, Maryut Lake is a body of shallow brackish water that occupies about 17% of its original size. It consists of two sections separated by a number of causeways and canals. The main body of the lake is nearly rectangular in shape, with its northern coast extending for about 20km, while its eastern coast is about 12km long. It has also been divided into many sub-basins, which are used for industrial and agricultural purposes. Moreover, its shores are subject to continuous irrigation, drainage and reclamation projects, which make it constantly changing and unstable. The second part of the lake takes the shape of a narrow arm that extends westwards for about 40km west of Alexandria. It is about 3km wide and is delimited from the north and south by two coastal ridges. This western arm also contains an elongated Island which is about 4km long and 500m wide. Much evidence indicate that the western extremities of the Lake Mareotis and its associated Island reflect the extant remains of the original lake that has not been subject to dramatic changes since antiquity.

Since the lake receives its water from groundwater seepage, agriculture runoff and rainfall; its water level fluctuates widely according to the seasons. In the rainy winter season, the water precipitates through the ground to raise the water level of the sub-basin, while in the dry summer season, high rates of evaporation contribute to lowering the water level.

The Project

The principal objective of the Lake Mareotis Research Project is to undertake a detailed systematic survey of the western extension of the lake in order to record, quantify and assess the archaeological resources of the area in a comprehensive manner. By doing so we aim to acquire a better understanding of the nature and extent of economic and maritime activities in

the Mareotic region, which would help shed light on what could be one of the key elements in the economy of Greco-Roman Egypt.

Previous archaeological research conducted around the shores of Lake Mareotis has been largely limited to specified areas and specific issues, such as the work of El-Fakharani (1983), amongst others, on the Byzantine port of Marea (Philoxenite), Empereur & Picon (1986, 1998) on the amphorae and wine production in Mareotis and Rodziewicz (1998) on wineries in the Mareotic regions (Fig. 4.). However, the pilot survey which we carried out in 2004 along the shores of Lake Mareotis western arm revealed that there are numerous archaeological sites in the region which have not been systematically studied. Moreover, the survey resulted in the identification of over ninety sites; more than two thirds of them were new discoveries (Fig. 5.). During that initial survey about 100km of the lake shore was covered and the exact position and basic data for all archaeological features that had been constructed in close relation to the ancient shoreline were recorded in preparation for a detailed survey in the following seasons.

During the subsequent seasons, in 2006 and 2007, a detailed systematic investigation was carried out for archaeological sites located along the southern shore of the Mareotic arm and the shores of the Mareotis Island. The sites were prioritised for detailed survey based on their archaeological value and the degree of threat to which the sites were subject. The survey included a topographical survey of each site carried out using a GPS-based Real Time Kinematic (RTK) satellite navigation system, which provided a high level of accuracy. Also a number of specific buildings/features were planned in detail using a Total Station and the data down loaded on site into AutoCAD via TheoLt software. Moreover, a magnetometer survey was carried out at some sites in order to determine whether or not there were any structures beneath the sediments. Finally, ceramic assemblages were collected from all sites for identification and dating purposes and to help determine the nature and function of each site. The survey was aided by a high resolution Quickbird satellite image of the Mareotic arm which is used as a base for a Geographic Information System that will incorporate different types of survey data (Fig.6).

Fieldwork

• Topographical Survey

The basic technique underlying a topographic survey is to measure the position of a point relative to the position of another, known, point. The relative heights and distances of the measured points to the known point are recorded. If this procedure is repeated in a systematic way, a model of the surface of a site or area can be developed. Large-scale topographic surveys have been carried out using a variety of equipment. Traditionally, tools such as Theodolites or Total Stations have been used. In the last few years the advent of widely available Global Positioning System (GPS) technology has resulted in its application to building and terrain surveys. GPS based systems offer an added advantage when compared to more traditional techniques, namely that they can accurately record the global position of a site as well as the topographical features of that site. This attribute is particularly advantageous when a regional survey incorporating a number of sites is being conducted. In this instance it is desirable to be able to accurately position such sites relative to one another.

A secondary function of the GPS survey system is its ability to accurately locate the positions of the survey grids used for the ceramic survey and the CAD stations used for building survey, relative to the rest of the site.

The Lake Mareotis Project utilised a GPS based survey system. A Leica GPS500 unit was used as the reference station while a Leica GPS1200 unit was used as the mobile data recorder (Fig. 7). Such equipment allowed a relative accuracy within the survey of a single site of c. 1cm to be achieved. Data was processed using Leica Geo Office and ArcMap software. The GPS1200 is a backpack mounted unit with the option of a detail pole for surveying specific features. For the Mareotis survey the unit was preconfigured to take a reading when changes occurred to its horizontal or vertical position of 1m and 0.1m respectively. The standard transect used on all sites was at 5m intervals, except on particularly flat areas where a 10m transect width was chosen. In the summer 2007 field-season, the large size of the Mareotis Island required that two GPS1200 units were used in tandem by a pair of surveyors.

Nine sites were surveyed on the northern shore of Lake Mareotis, and a comprehensive topographic survey was conducted on Mareotis Island (Fig. 8.). The surveyed sites varied in size as well as in their physical nature. They ranged from small sites such as site 252 (c. 7000 m²) to very large sites such as site 207 (c.180,000 m²), and it varied from 'tell sites' focused around and defined by a hill or series of hills on the water's edge (204/205, 207/208), to much flatter sites with more uniform topography (214, 215).

- **Site Planning**

Specific archaeological features at a number of different sites were surveyed utilising a Leica Total Station TCR307, recording straight into AutoCAD 2007 via TheoLt. TheoLt is a survey program developed by Latimer CAD that allows the user to record information directly into AutoCAD, thus negating the requirement to transfer data from surveying software and enabling the surveyor to check the accuracy of the data as it is taken.

A total of 25 sites have been recorded to date on the north shore of the lake as well as on the Mareotis Island. A local grid was established for each site and each station was given a co-ordinate within its own grid. Readings were then taken on all of the stations using the RTK GPS to allow the surveys to be accurately geo-referenced and placed upon the topographic models. Once the topographic data is fully processed the CAD files will be overlain onto the maps of each site; thus allowing the relationships between features on individual sites to be assessed in greater detail and in relation to the topography of each site.

The surveyed sites included waterfront structures of a maritime nature, such as harbours, jetties and quays (Fig. 9), as well as a substantial series of rubble, stone and ashlar-built walls which were recorded close to the edge of the water and which could belong to storage facilities (Fig. 10). Moreover, a large pottery kiln and numerous structures associated with water management, such as cisterns, wells, vats and what appears to be a saqiya, were recorded (Fig. 11).

- **Magnetometer survey**

Preliminary geophysical survey was carried out using a GeoScan Research Fluxgate Gradiometer FM36 instrument. It was hoped that the results of the geophysics would provide us with insight into both the function of various parts of the Island and an indication of which areas had not been built upon in antiquity. This would then act as a guide when selecting areas to auger to determine changes in water level.

A total of three areas on Mareotis Island were surveyed using the magnetometer. The survey was conducted using grids of 20m x 20m, with the instrument recording a sample every 0.5m. The success of the survey was limited by the topography of the site and the vegetation – fearsome bushes rendered total grid coverage either painful or impracticable. Structures were, however, tentatively identified in all three areas surveyed. These initial survey results are awaiting further processing in the Digital Archaeological Laboratory at the University of Southampton where it is hoped that a clearer understanding of the relationship between the geophysical results and the extant structures will be achieved.

- **Ceramic Survey**

The collection of ceramic samples from the survey area was undertaken using three different sampling techniques (Fig. 12). In all cases only rims, handles, bases and decorated/stamped examples were collected. Firstly, pottery exposed whilst cleaning archaeological sites was collected. Secondly some sites on the Island were surveyed intensively using 20 x 20m grids. The purpose of this method was to assess the extent of these settlements over the course of their occupation. The rest of the sites were surveyed using a system of pottery circles, centred on concentrations of pottery, 10m in diameter. All areas of pottery collection were surveyed using RTK.

Preliminary processing of the collected samples indicates that ceramics dating from the Hellenistic period into the seventh or potentially through to the eighth century AD were found on the north shore and the Island. The distribution of pottery and extent of occupation at different sites varied greatly over time. With the exception of a few modern sherds and some unidentified sherds, all pottery found appears to be limited to these periods.

Assemblages from the northern coast of the lake dates from the Hellenistic to Late Roman period and it includes a mixture of amphorae, fine wares, tableware's and cooking wares. Much of the fine wares and amphorae were imported. On the other hand, ceramic forms found on the Mareotis Island consist mainly of amphorae sherds, supplemented with a variety of fine ware, tableware, and cooking and coarse wares. The origin of most of the pottery was local, which is understandable considering the presence of kiln sites around the Mareotic region and indeed on the Island itself, which highlights the importance of the Mareotis Island in producing amphorae through the Hellenistic and Roman periods (Fig. 13).

The complete collection of ceramic samples is currently at the Maritime Museum in Alexandria. The samples have been separated into boxes according to their dates ready for specialists' detailed review at a later point.

Results and Forthcoming Work

The sites surveyed until present extend along the northern coast of Lake Mareotis western arm and on the Mareotic Island. The survey has explored several features reflecting economic activities in the region including numerous maritime structures which could have been used for receiving and dispatching merchant vessels, as well as what could be warehouses and storage facilities (Fig. 14). The survey also revealed abundant evidence for industrial activities, mainly amphora production, which included kiln structures, ceramic slag and kiln wasters, which correlates with much archaeological and textual evidence for viniculture and wine production in the region including the existence of a number of wineries in the Mareotic region which date from the early Roman to the Byzantine period (Fig. 15).

It was also realised during the survey that there is a possible spatial and functional relationships between some sites on the Island and other sites on the northern coast. For example, it was noticed that sites 202/203 on the northern shore of the lake are opposite a cluster sites located on the eastern end of the Island (Fig. 16), while site 204 on the northern shore of the lake is opposite to site 23 at the western end of the Island, which contains a jetty that extends to the north towards the jetty at site 204. Further study of the ceramic collections from these sites and the changes of water level will shed more light on any functional relations between them. Limited excavation of a number of structures at the east and western ends of the Island revealed that most of these structures had been subject to several building phases, which was probably influenced by fluctuation of water level in the lake as well as the problem of siltation affecting the Island's north shore. However, further work will enable us to have a better idea of the nature of those sites and their association with the water level.

During the forthcoming season, which will take place in the summer of 2008, archaeological sites located along the southern cost of the Lake Mareotis western arm will be systematically surveyed. Subsequently, all data will be compiled into a GIS which will represent a significantly enhanced archive of the region's archaeological resource and will provide scholars with much needed data upon which future research can be based.

Acknowledgement

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Figures



The survey team for the summer 2007 season

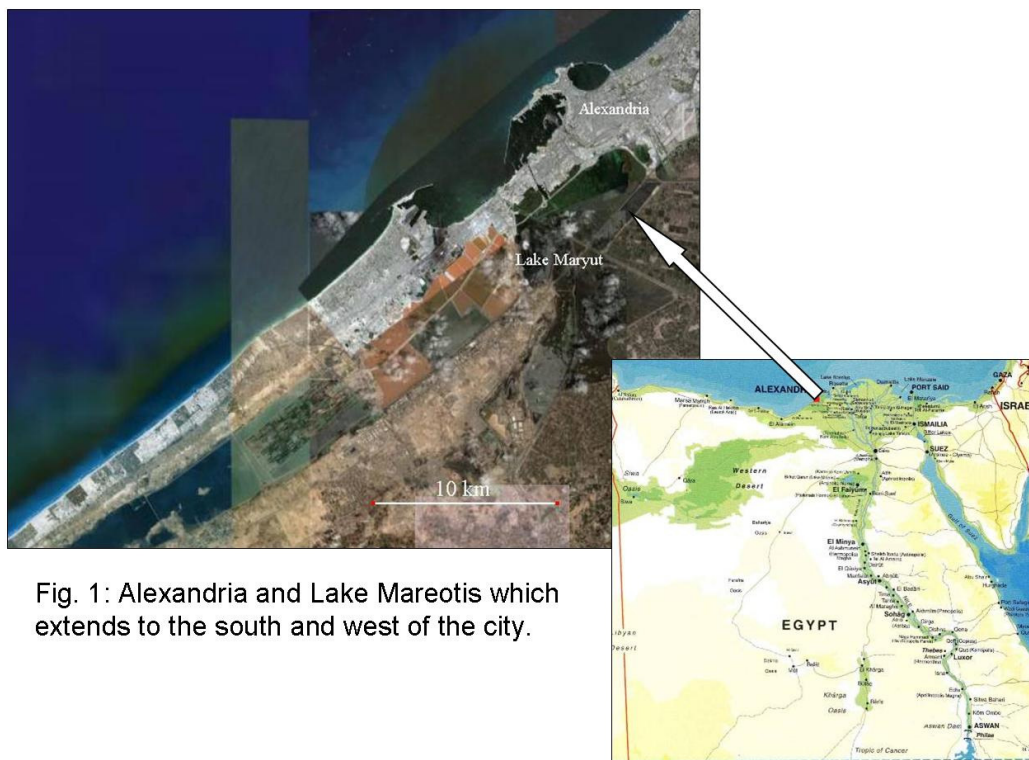
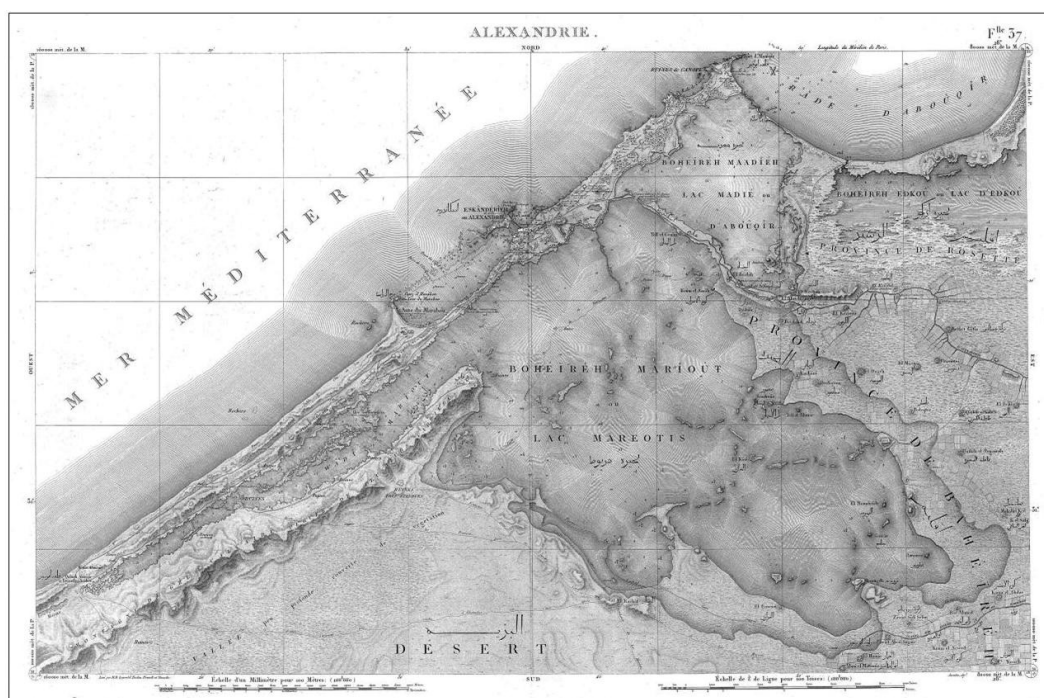
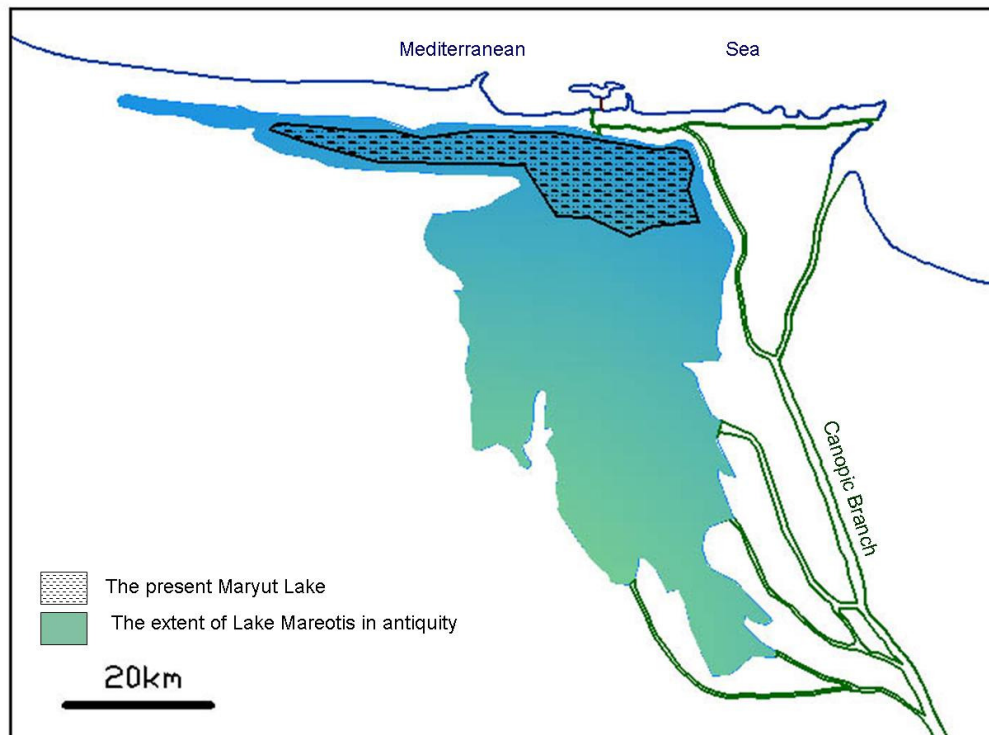


Fig. 1: Alexandria and Lake Mareotis which extends to the south and west of the city.



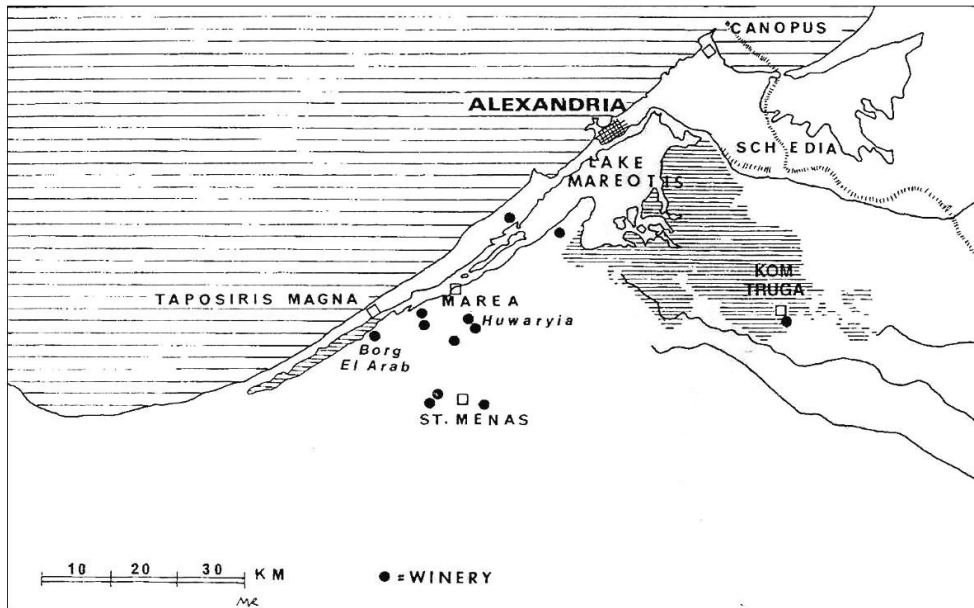


Fig. 4. Wineries which date from the Hellenistic to the Byzantine period identified by Rodziewicz (1998) in the 1980s.

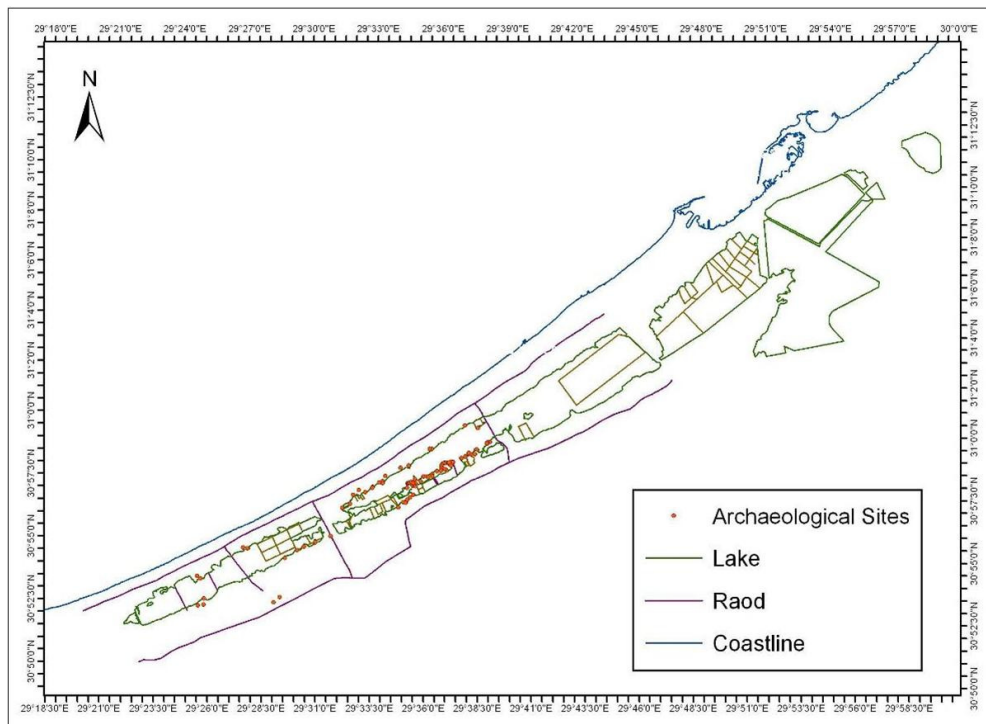


Fig.5. The main body and the western arm of Lake Mareotis. Red dots indicate archaeological sites located during the pilot survey in 2004.

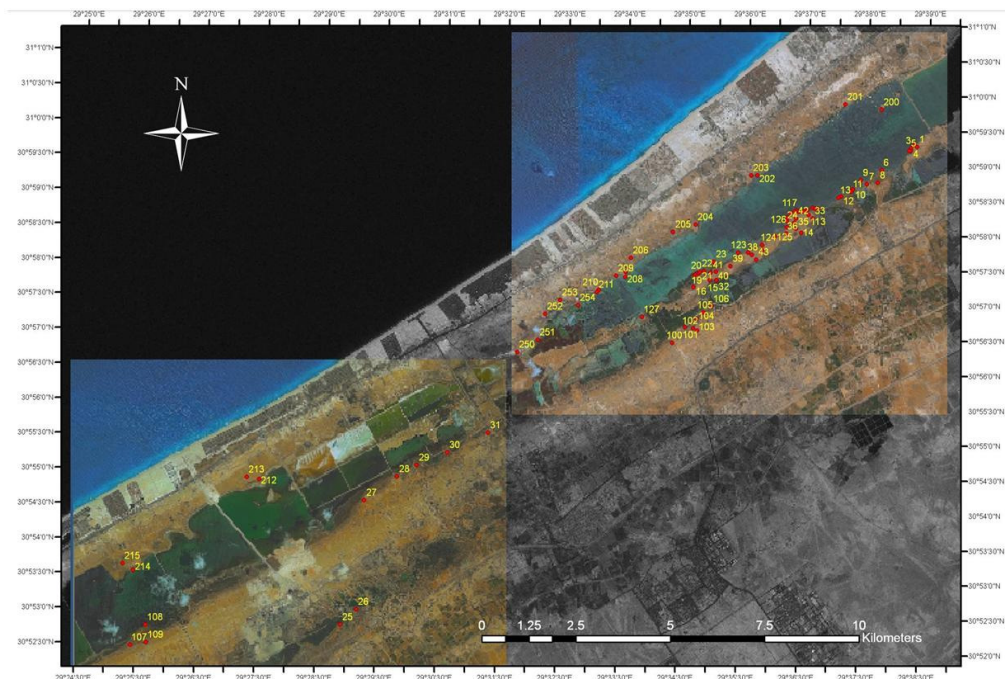


Fig. 6. The whole area covered during the survey. The numbers indicate archaeological sites that have been identified. The Mareotis Island is located at the north east side of the surveyed area.



Fig. 7. Julian Whitewright and John Cooper setting up the RTK system for the topographic survey on site 208 at the northern shore of the lake.

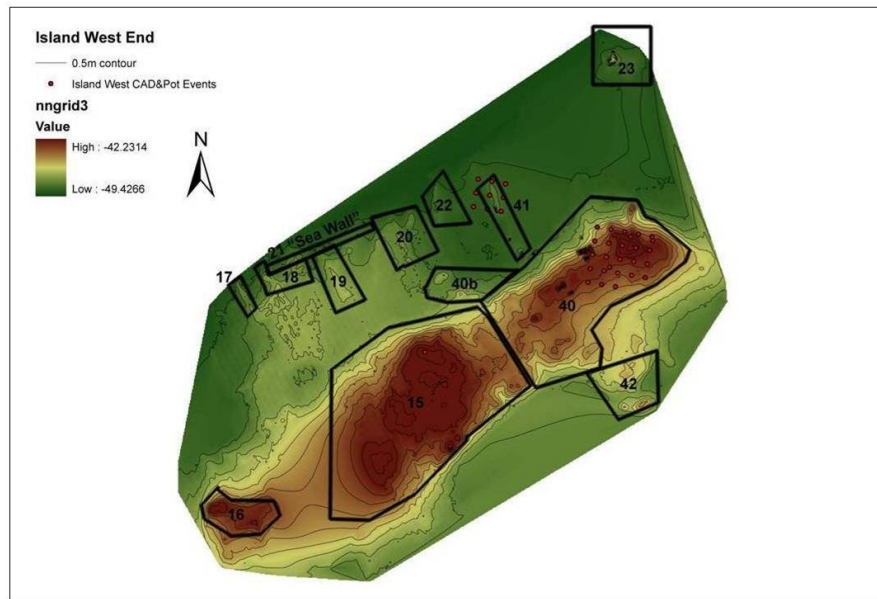


Fig. 8. The topographic survey of the eastern end of the Mareotis Island. Numbers indicate areas containing archaeological remains.



Fig. 9. One of the main harbours recorded at the southern shore of Lake Mareotis

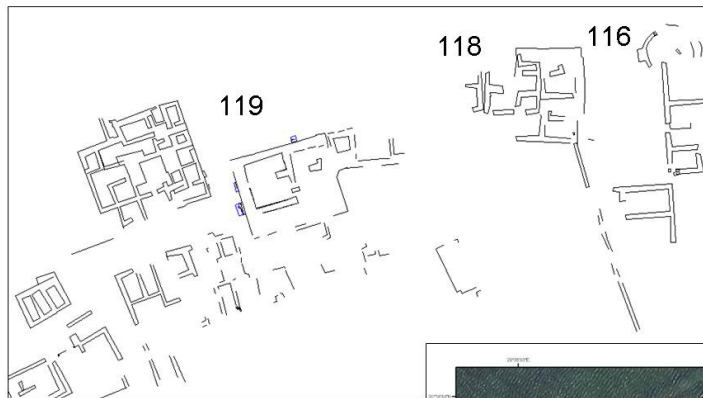


Fig. 10. (Right) Sites 115-120 located along the northeast shore of the Mareotis Island.

(Above) A plan of the structures at sites 116, 118 & 119 on the north-east shore of the Mareotis Island. The water front structures could have been used for storage purposes.

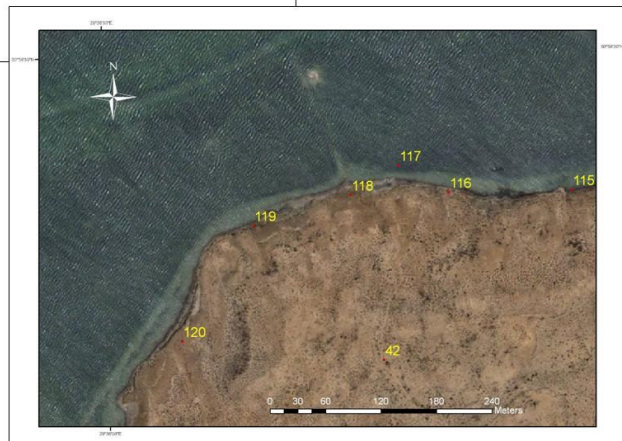


Fig. 11. The entrance of a Roman cistern at site 205 on the northern shore of the lake. Walls of the cistern are lined with watertight mortar (Opus Signinum).



Fig. 12. Mounds of pottery wasters and amphora sherds along the shores of the lake indicate intensive amphora production.



Fig. 13. John Cooper photographing the details of an early Roman amphora kiln that was discovered during the survey.



Fig. 14. The remains of several coastal structures were cleaned and planned during the survey



Fig. 15. One of many wineries in the Mareotic region, an indication of a once thriving wine industry.

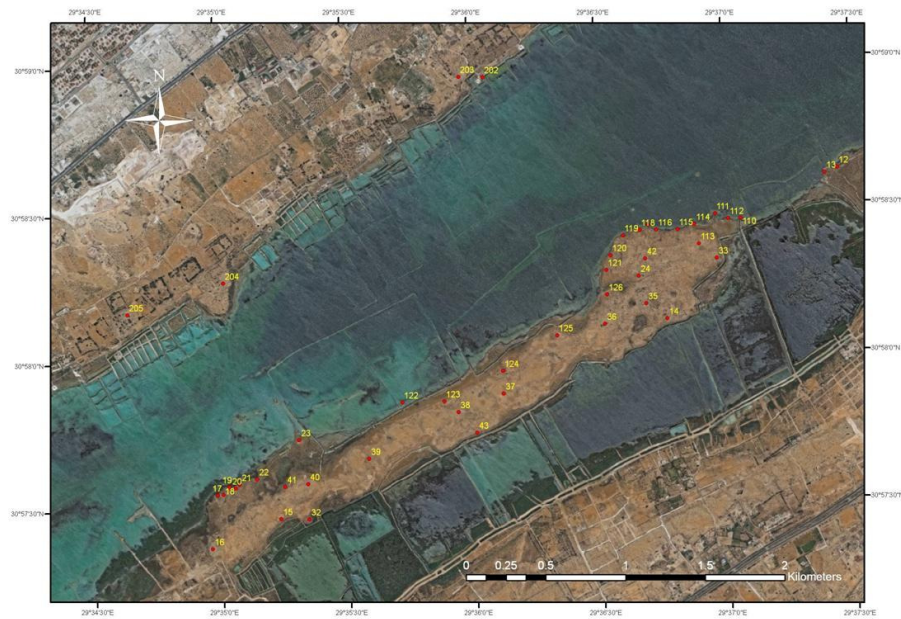


Fig. 16. Sites identified on the Mareotis Island. It was noticed that sites 202/203 on the northern shore of the lake are opposite to the cluster sites at the eastern end of the Island which could indicate a spatial and functional relationship between them.



Fig. 17. Lucy Blue instructing Alexandria University student Ahmed Gaber on excavation techniques.