Heritage in Peril

A Vulnerability Assessment of Ancient Sites in Greece with Regard to Both Human and Natural Destructive Factors

Introduction and Background

Ancient sites across the world are constantly in danger of destruction from natural forces and human actions. Efforts to protect these sites, which hold extremely valuable and irreplaceable information about the past, must be made quickly in order to preserve them. This project assesses the sites in Greece to determine which ones are particularly vulnerable to destruction through a series of GIS operations. There are many factors that influence the vulnerability of a site. This project focuses on two categories: natural and human. The natural impact on archaeological sites is primarily due to climate change, threatening coastal sites with rising sea level and even inland sites with increased risk of natural disasters and changing weather patterns (Rowland, 1992). The human influences are more numerous and destructive. Ancient sites are sometimes used as backdrops for cultural events such as plays, films, and other events, and this use can be harmful to the delicate preservation of sites (Hartzoulaki, 2019). Urban development, however, is the most destructive process occurring at, near, and around archaeological sites. For example, the development of the Metro system in Athens threatened the stability of monuments across the city and displaced millions of artifacts (Scrippscasts, 2012). The protection of these sites is growing increasingly difficult due to the economic recession in Greece and the lack of funding for preservation (Kakissis, 2014). In accordance, this project studies eight destructive factors: railways, major roads, minor roads, coastlines, waterways, modern cities, land use, and category of site to determine the degree of influence each factor has on the potential destruction of a site. Knowing which sites are most vulnerable to destruction according to these factors can inform the placement and prioritization of funding for preservation.

Cumulative Site Vulnerability in Greece

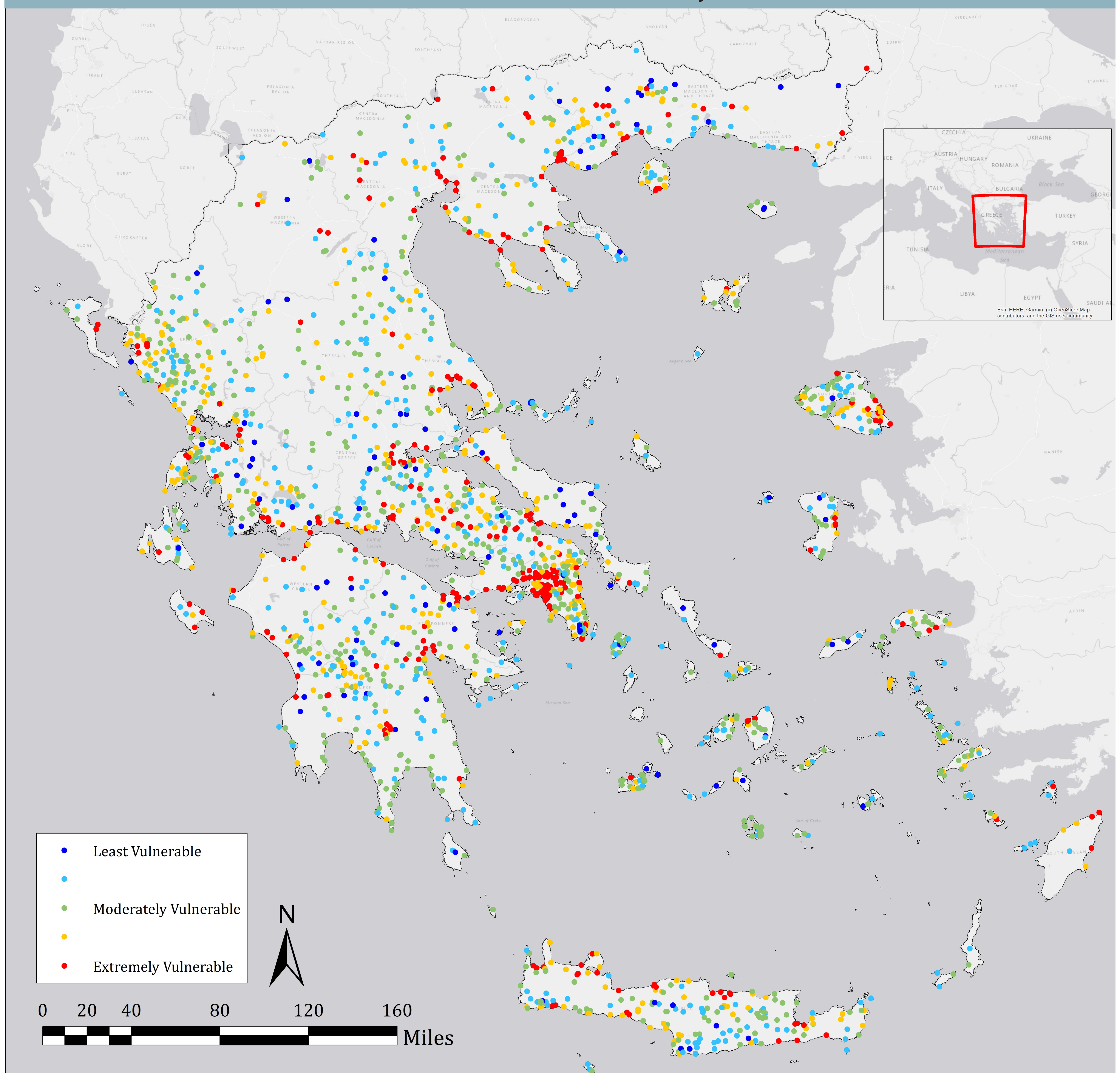

Figure 9: Total Vulnerability of Sites in Greece.
Summation of individual vulnerabilities, 0-32, with 0 representing the least vulnerable sites and 32 representing the most vulnerable sites. This map shows the vulnerabilities split into five groups via Natural Breaks in the data. The "Least Vulnerable" symbol represents vulnerability values of 0-7. The three intermediate symbols represent vulnerability scores of 8-12, 13-16, and 17-20 respectively, or sites with intermediate vulnerabilities. Finally, the "Extremely Vulnerable" sites are those with scores of 21-32.

Methods

Using ArcMap 10.7, individual vulnerability rankings (all beginning with 0) were recorded in new fields in the attribute table for the sites for each of the eight destructive factors considered, that were added together to determine a total vulnerability score ranging from 0-32, with 32 being the most vulnerable to destruction. Proximity to identifiable destructive factors was determined through the use of buffers and vulnerability scores were assigned after using a spatial query to select features within these buffers (Figure 1-6). Each buffer's size was chosen to match the relative spatial influence of the factor. Railroads and roads have only a half-mile buffer placed around them because in order to construct a railroad or road, no more than half a mile of land on either side of the path would be disturbed (Figure 1-3). In the case of coastlines and waterways, three buffers (.5, 1, and 2 miles) were made to represent different levels of potential water-level rise and the ranging impact that these would have (Figure 4-5). Because urban construction is so destructive, modern cities were given the most and largest buffers, 2, 5, 10, and 20 miles from the city center, where sites nearest the city center are given the highest vulnerability score (Figure 6). A more qualitative approach was used for the final two factors. Land use, whether natural/protected or not, was used to separate sites through a spatial query, scoring sites on human occupied land higher than those in natural areas (Figure 7). Finally, the sites themselves were divided into three categories based on the attribute "site type." The vulnerability scores placed with these categories corresponded to the likelihood of the sites use in modern times as either a tourist attraction or as a location for a cultural event: natural sites (i.e. groves, etc.) = 0, unlikely sites (i.e. graveyards) = 1, and likely sites (i.e. villas or temples) = 2 (Figure 8).

Results

The individual vulnerability assessments show how different factors affect different sites. Figures 1-8 show that there is no one greater pattern to site vulnerability, which is why many destructive factors must be considered in order to achieve a clear picture of site vulnerability across the country. Figure 9 shows the total vulnerability ranking of sites across Greece. The most vulnerable sites tend to be found near the coast, though there are vulnerable sites further inland. Pockets of vulnerable sites in Figure 9 tend to correspond in location to the cities shown in Figure 6, which could be the result of multiple factors being geographically associated with cities. Surprisingly, there were sites that had a zero as their vulnerability score, and no sites that had a score of 32.

Conclusion and Discussion

The results of this study identify the most and least vulnerable sites in accordance with the eight natural and human influential factors studied. Each factor was considered with equal weight in an attempt to neutralize any bias present in the data and analysis, though future studies could choose to weight factors differently. The highest concentration of vulnerable sites appears to be near Athens on the Peloponese, which is not suprising, as Athens has been a major site of human occupation throughout history. Nor is it suprising that coastal sites were also particularly vulnerable, as coasts and waterways were often settled because of their proximity to resources and opportunities for sea trade. Knowing the locations of sites that are most vulnerable to destruction is incredibly important to preservation efforts as insufficient funding is the unfortunate reality in preservation (Kakissis, 2014). This research can be used in grant applications or appeals to the government to direct those funds to the most vulnerable sites.

While this data is carefully considered within the scope of this project, there are certain limitations that must be taken into account. First, the sites are modeled as points, whereas in reality, they take up a varying amount of space. A future study could use polygons to represent each site, and use the total area of the site as another factor influencing vulnerability. A limitation to the analysis is that the buffer sizes were based on reasonable estimates rather than spatial statistics, which are not widely available in the context of a zone of potential destruction or influence. Another analytical limitation concerns the modern cities; their relative sizes could have an impact on how destructive they could be but, like the sites, were also modeled as points. Future studies, similar to those performed by Minos-Minopolous et. al. analyzing the effects of earthquake activity on ancient sites, may take a more detailed approach to natural factors, such as climactic data that predict sea level rise more accurately than a buffer system, and geologic data to investigate how erosion, tectonic activity, and landscape might influence the vulnerability of sites.

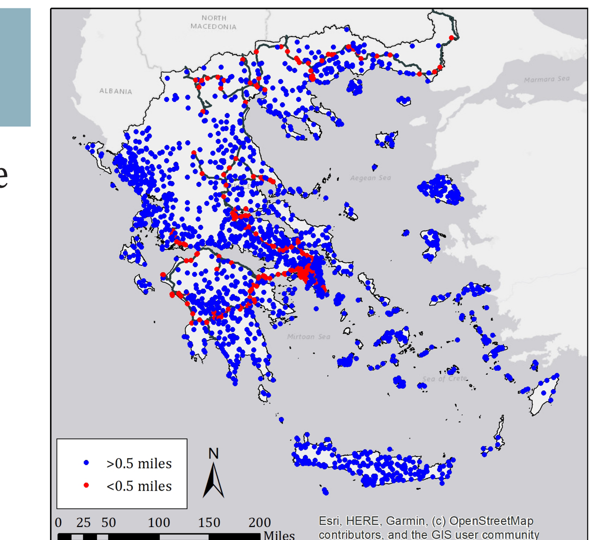

Figure 1: Modern Railways.
Vulnerability of sites assinged vulnerability values (0, 4) based on location, further than half a mile away from railways or within half a mile, respectively.

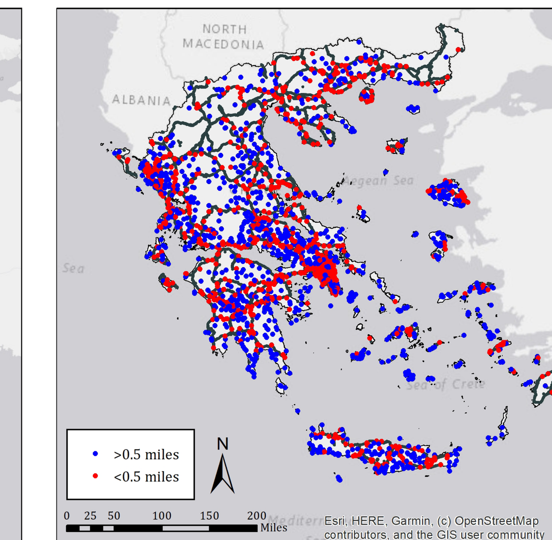

Figure 2: Major Roads.
Vulnerability of sites assigned vulnerability values (0,4) based on location, further than half a mile away from major roads or within half a mile, respectively.

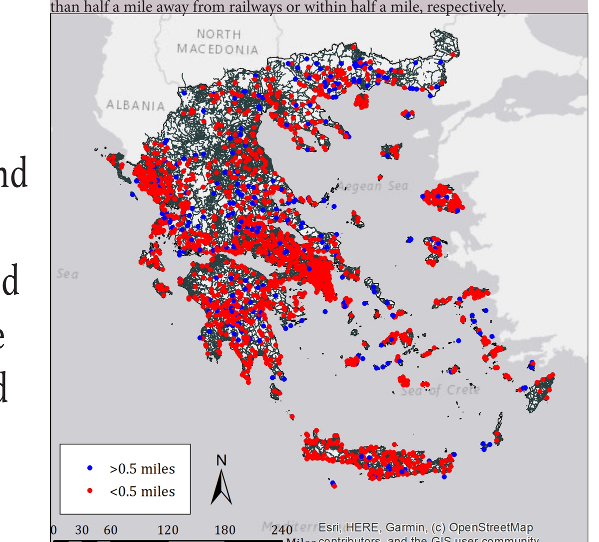

Figure 3: Minor Roads.
Vulnerability of sites by assigned values (0, 4) based on location, further than half a mile away from minor roads or within half a mile, respectively.

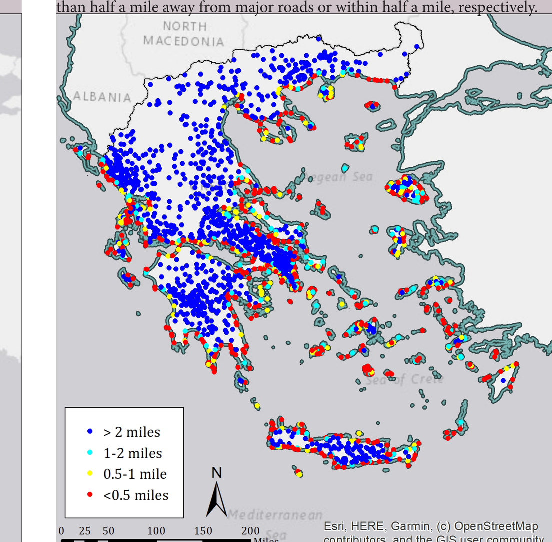

Figure 4: Coastlines.
Vulnerability of sites assigned values (0, 1.33, 2.67, 4) based on proximity to coastlines.

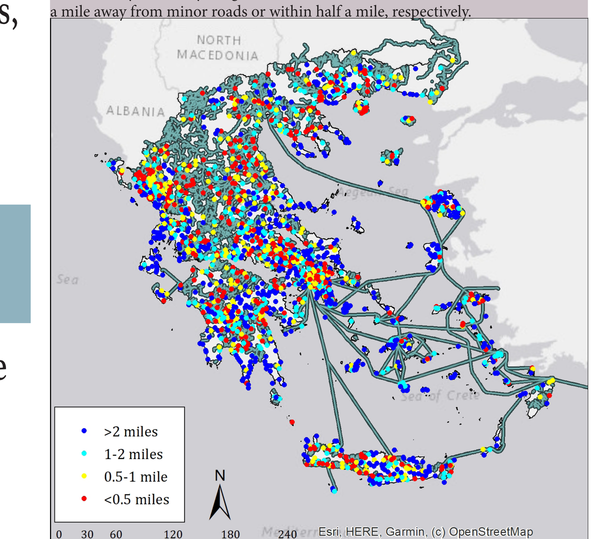

Figure 5: Waterways.
Vulnerability of sites assigned values (0, 1.33, 2.67, 4) based on proximity to waterways.

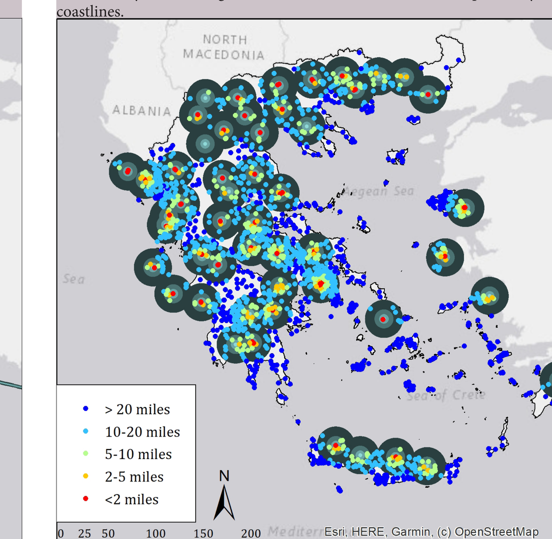

Figure 6: Modern Cities.
Vulnerability of sites ranked 0-4 based on proximity to cities: 4=within two miles, 3=within 5 miles, 2=within 10 miles, 1=within 20 miles, 0=beyond 20 miles.

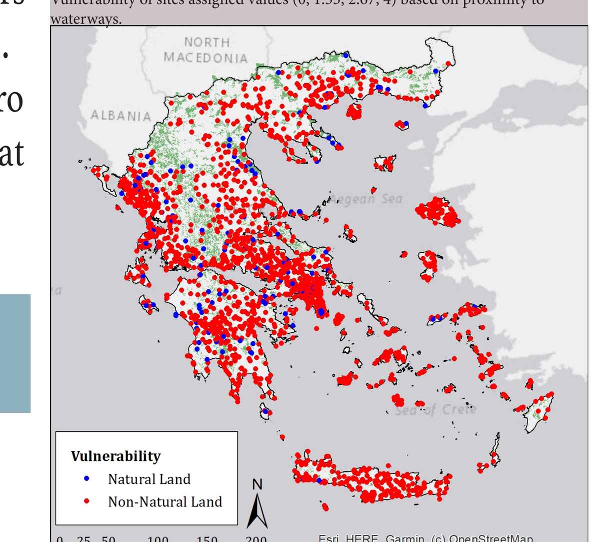

Figure 7: Land Use.
Vulnerability of sites assigned values (0, 4) based on land use: 0=natural/protected land, 4=unprotected land/land used by humans.

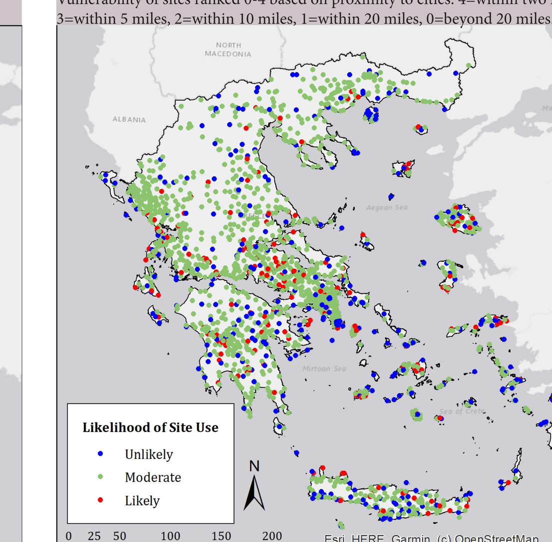

Figure 8: Type of Site.
Vulnerability of sites assigned values (0, 2, 4) based on type of site: 0=unusable sites, 2=unlikely to be used, 4=likely to be used.

Data Sources:

Sources for Analysis and Visualization:
Ancient Place Names, 2020, Pleiades.
Waterways, 2020, Open Street Map.
Railways, 2020, Open Street Map.
Roads, 2020, Open Street Map.
Greece, 2020, Institute for the Management of Information Systems of the "Athena" Research and Innovation Center in Information, Communication and Knowledge Technologies.
Coastline Lines, 2020, Open Street Map.
Natural Features, 2020, Open Street Map.
Cities in English and Greek, 2020, Institute for the Management of Information Systems of the "Athena" Research and Innovation Center in Information, Communication and Knowledge Technologies.

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Kakissis, Joanna (2014, September 8). Archaeologists Chase Private Funds to Preserve Greek Antiquities. NPR. https://www.npr.org/sections/parallels/2014/09/08/345561110/archaeologists-chase-private-funds-to-preserve-greek-antiquities

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Rowland, M. J. (1992, June). Climate Change, Sea-Level Rise and the Archaeological Record Australian Archaeology, 34, 29-33. https://www.jstor.org/stable/pdf/40287091pdf?refreqid=excelsior%3Ad031af5b81b122b8c06f05ab511e057c

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Projection: Greek Grid: Transverse Mercator Projection.

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