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Mining activity and island landscape issues: evidence from Cyclades islands, Greece

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ABSTRACT

This paper maps the visual impact of mining activities on terrestrial and marine landscapes of the Cyclades islands, Greece, an island complex in the Aegean Sea of particular natural and cultural heritage. In the nineteenth and twentieth centuries, mining activities developed on the islands, many of which are abandoned today. Some of the remaining inactive mines and accompanying structures have been registered as monuments and part of the national industrial heritage. The remaining active mining units conflict for land with the main economic activity today, tourism. The visual impact of the mining units is calculated and mapped, resulting in viewshed analysis which quantifies the impact of mining units on terrestrial and marine landscapes, with emphasis on nominated traditional settlements and mention of non-traditional ones. The quantitative results have shown that the landscape study needs to be incorporated in terrestrial and marine spatial planning.

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1. Introduction

1.1. Landscape management and protection

1.1.1. Land-use conflicts and landscapes

The definition of the landscape is a complex and multidimensional issue (Kizos et al. 2010). This is highlighted in the definition of the landscape adopted by the European Landscape Convention (ELC): '… landscape is an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe 2000). Perception comes out as an important factor of this definition and different observers can perceive it visually, acoustically, olfactorily, etc. It also brings forward the dynamic nature of the landscape from natural processes and human activities, and consists of both tangible and intangible features (ICOMOS 2008; Kizos et al. 2010: Marcucci 2000). This complex character of the landscape presents challenges for its study (Reed et al. 2020).

Another very important issue that stems from the ELC is that mention of 'landscape' does not concern only outstanding landscapes but also 'ordinary' ones. All landscapes organically evolve with the socio-spatial system within which they have developed

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(Fowler 2002); they are also subject to change. If these changes are managed under sustainable development strategies, the landscape could maintain its identity (ICOMOS 2014), but often human-induced changes exert intense pressure on it, often leading to its degradation (Antrop 2005).

The Mediterranean region has undergone significant land use and consequently landscape changes many times over its long interaction with human societies (Falcucci, Maiorano, and Boitani 2007; Geri, Amici, and Rocchini 2010; Serra, Pons, and Saurí 2008). In recent years, some of the most important changes are related to the abandonment of land management in mountainous areas with a consequent increase in forest areas and the increase of activities in plains as well as the intense population concentration and tourism development in coastal zones (Falcucci, Maiorano, and Boitani 2007; Parcerisas et al. 2012; Plieninger et al. 2016). These changes have exerted intense pressure, especially on coastal landscapes which are areas of rapid development and competition of many different land uses. Landscape changes can be studied with many different approaches, on different scales demonstrating the complex and multidimensional landscape character (Bürgi et al. 2017). These new spatial pressures, sometimes combined with inadequate spatial planning for the landscape, have led to loss or degradation of the cultural landscape, such as rural structures, industrial heritage structures etc. and, therefore, to the loss of place identity (ICOMOS 2008).

The landscapes of islands are more fragile due to the special characteristics of their socioecological systems. They are characterized by small size (and population) and limited space, resulting in relatively limited natural resources as well as by geographical fragmentation and discontinuity, which brings isolation and peripherality (Spilanis, Kizos, and Paraskevi 2012). These limitations make landscape impacts of large-scale activities on islands very important. Islands' natural and cultural environment, combined with the interaction of the coastal and marine zones, make them attractive for tourist activities. The tourism sector is dominant in employment on islands in the last decades, constituting a monoculture in some of them and replacing primary and secondary productive sectors (Tsilimigkas and Kizos 2014). Other uses that are still found on them such as mining, aquaculture, renewable energy etc., conflict – often with high intensity – with tourism, especially when they are located in coastal or marine spaces (Tsilimigkas and Rempis 2018; Vlami et al. 2020). But even if spatially some of these incompatible land uses are not in close proximity, they can interact visually (Tsilimigkas, Rempis, and Derdemezi 2020).

1.1.2. Landscape management

The first acknowledgement of the importance of landscape was in 1972 in the 'Convention concerning the protection of the world cultural and natural heritage' (UNESCO 1972), where the landscape was perceived as a 'work' of man and nature. The concept of landscape protection has been extended to a holistic perception that applies to all types of landscapes, exemplified in the European Landscape Convention (Council of Europe 2000) that has attempted to resolve conceptual issues of landscape and to establish a common European strategic framework, while establishing the need for landscape protection and management. In Greece, the European Landscape Convention has been adopted by Law 3827/2010 (OGG 2010). Despite the time lag, it has been the most important step towards integrated landscape protection and management replacing the many and fragmentary references to landscape in various laws that mainly concerned landscapes of outstanding natural or cultural value.

For coastal areas and the coastal landscape, the Barcelona Convention on the protection of the marine environment and the coastal region of the Mediterranean has been considered as an important step towards its sustainable management (United Nations 1995), signed by twenty-one Mediterranean countries and the European Union (EU). An important protocol for the landscape is the Integrated Coastal Zone Management (ICZM) in the Mediterranean (OJEU 2009) with the objective to ensure a balance between socio-economic development and environmental and landscape sustainability through spatial planning.

Efforts for integrated marine space management started in 2007, when the EU adopted the Integrated Marine Policy (IMP) (CEC 2007). In 2008, the European Parliament and Council (EP&C) adopted the Directive 2008/56/ EC on Marine Strategy (MS) (EP&C 2008). In 2013, the EP&C adopted the Proposal for a Directive 2013/133 that established an integrated framework for Marine Spatial Planning (MSP) and Integrated Coastal Zone Management (ICZM) (EP&C 2013). In 2014, the Directive 2014/89/EU 'establishing a framework for marine spatial planning' of the EP&C developed principal guidelines for a common framework for MSP. Its implementation in Greece was Law 4546/2018 (OGG 2018a). The way in which the protection and management of the marine landscape will be integrated as an issue in the marine plans is yet to be documented.

1.2. Mining activity on islands

1.2.1. Mining activity and economic, social and environmental issues

The Cyclades are an island complex of the Aegean Sea, consisting of 24 inhabited islands and numerous uninhabited islets (total area 2581.5 km^2), part of the South Aegean region (Figure 1). Most of the islands are characterized by fragmented and hilly terrain. From a geological point of view, the volcanic arc that crosses part of the islands has created rich subsoil and geothermal energy (Kougioumoutzis and Tiniakou 2015; Valsami-Jones et al. 2005). This subsoil has been known and exploited since antiquity, with visible remnants. In the modern era, the first systematic mining research and exploitation in Greece dates back to the middle of the nineteenth century and has been intensified since 1860. Law 'On mines' of 1861 contributed to this with provisions for mines and quarries (OGG 1861); under that Law, the ownership of the land was separated from mining property (Fragkiskos 2009). At the time, the Cycladic islands were mining centres and in many cases, the mining sites coincided with those of the ancient ones, but many new ones were created too. Today, mining activities continue on several islands, with the highest intensity on Milos from which large quantities of perlite and bentonite are mined every year, putting Greece among the top pearlite and bentonite producers globally (Mavrommatis and Menegaki 2017), whereas very good quality marble is mined on Naxos, Paros and Tinos (Belavillas and Papastefanaki 2009).

The permanent population of the Cyclades is roughly 100,000 people (ELSTAT 2011). Although in the past, the primary and secondary sectors were very important economically on the islands, today tourism has taken over (Kizos, Tsilimigkas, and Karampela 2017; Sakellariou et al. 2016). From the nineteenth until the middle of the twentieth century, the sector of mining activity flourished. In most cases, the exploitation lasted a short period of time due to either poor mineral materials or to the unregulated

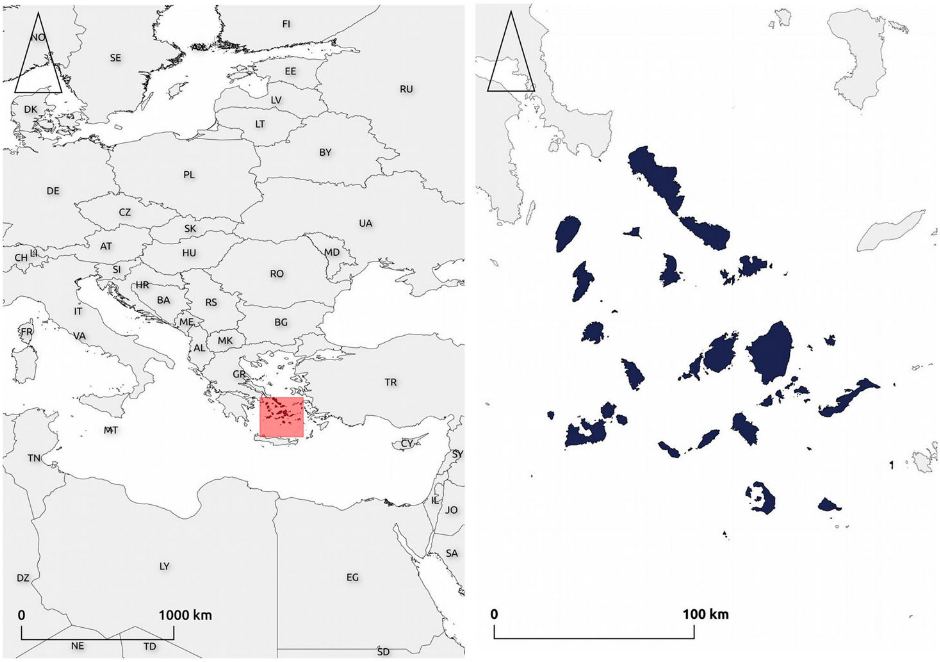

Figure 1. Location map for Cyclades islands. Source: Authors' analysis.

mining and the inappropriate organization of production, replaced by tourism development after the 1970s, eventually leading to land-use conflicts between mining activities and tourism development. A typical example is the gradual ban of mining of Theraic earth from the side of the caldera of Santorini, which began in the 1970s, and the mining units were gradually being closed down until the 1980s. On the islands, an extensive network of traditional settlements is found, characterized and protected by Presidential Degrees (PD) 595/D/1978 (OGG 1978) and PD 504/D/1988 (OGG 1988).

1.2.2. Mining activity and land-use synergies and conflicts

Although mining has economic benefits, its activities also exert environmental pressures (EC 2010; Goudouva et al. 2018) and cause social conflicts (Rivera 2020). It is today an important sector of the Greek economy since domestic resources are used in productive activities such as energy production, cement industry and constructions and mineral raw materials are also exported (FEIR 2016; MEECC 2019). Mining is an activity with a strong spatial footprint (Tsilimigkas and Derdemezi 2020a). Small-scale activities that characterize islands often make large-scale mining interventions incompatible with landscape continuity (Tsilimigkas and Derdemezi 2017). Today, the most important activity on islands is tourism (Prokopiou et al. 2018), which is directly related to the quality of their landscapes. The close proximity of the two productive activities, i.e. tourism and mining, even visual contact, creates conflicts in economic activities and land use. A typical example is that of Milos where the conflict of tourism – mining is strongly expressed by stakeholders (Lichrou and O'malley 2006). On the one hand, mining, combined with any lack of rehabilitation of the abandoned mines, leads to gradual landscape degradation

(Mavrommatis and Menegaki 2017), whereas, on the other hand, mass tourism can also have a negative impact on the natural and cultural landscape of the islands, mainly through unregulated built-up area expansion (Tsilimigkas and Derdemezi 2020b).

The mining units in which, after the end of their operation, no rehabilitation effort is made, remain in the landscape as deep scars with negative environmental and cultural impact (Coratza, Vandelli, and Soldati 2018). Following proper study and integral spatial planning, the abandoned mines could have many different reuses depending on their position and the particular characteristics of the area (Coratza, Vandelli, and Soldati 2018), such as restoration and conservation of natural environment (Charvalas et al. 2021; Fadda, Fiori, and Matzuzzi 2010), agricultural development (Dal Sasso, Ottolino, and Caliadro 2012), residential and industrial development, recreation facilities (Kaliampakos and Mavrikos 2006). Several scientific reports recognize mining sites and their support structures as part of industrial heritage and geoheritage (Conlin and Jolliffe 2011; Hvizdák et al. 2012; Mateos, Durán, and Robledo 2011; Matos et al. 2012). Thus, via proper protection and management of inactive mining units, geotourism and industrial tourism could be developed (Kaliampakos and Mavrikos 2006; Margiotta and Sanso 2017; Nita and Myga-Piątek 2014).

Geotourism is a branch of tourism that specifically focuses on geology and landscape. The geotourism presupposes the tourists' informing about the geoheritage and the ways of protection and management of the landscape, contributing to the sustainability of the place (Dowlling 2013; Dowlling and Newsome 2018). As with any form of tourism, in order for geotourism to develop successfully and to contribute to geoheritage and sustainability of the place, it ought to be developed through integrated planning (Newsome and Dowling 2018). Due to its significance, geotourism is growing fast worldwide and especially in coastal areas (Rutherfold, Newsome, and Kobryn 2015). The coastal areas of the Mediterranean, Italy, Malta and Greece, have geological and geomorphological features of great interest. The particular landscapes suffer the pressure of big-scale human activities and mass tourism. However, these areas have particular potential for geotourism development, which could lead to awareness into geoheritage and, more broadly, in environmental and landscape issues for both the public and the policymakers, thereby promoting sustainable tourism (Cappadonia et al. 2018; Coratza et al. 2016; Coratza et al. 2019; Selmi et al. 2019; Zouros 2007).

Concerning Greece and specifically the Cyclades islands in Aegean Sea, the most important monuments of the nineteenth- and early twentieth-century's mining activity are located on the islands of Serifos, Milos and Naxos. Both the aerial emery transport system of Naxos, nominated as the historic site (OGG 1989), and the smallest scales remnants, which are scattered on most Cyclades islands, create a network that illustrates industrial history. Nevertheless, industrial heritage requires special management and protection, so that the cultural landscape can cope with pressures from new activities and structures, such as the opening of roads, unregulated built-up expansion or even failure in their reuse (Belavillas and Papastefanaki 2009). Integrated industrial heritage management of the islands does not exist, leading to the ruin of the structures due to the lack of any maintenance. An extreme example is the island of Sifnos, where mining are an uncontrolled waste disposal site (UWDS) ['Choros Anexelegktis Diathesis Apovliton', in Greek]. Synergies could be established between industrial heritage and tourism, provided that industrial heritage will be managed within integrated spatial planning and promotional actions, with an aim to develop alternative forms of tourism, such as geotourism and cultural and industrial tourism.

1.3. The institutional framework of mining activities in Greece

In Greece, the legislation that covers minerals and mining activities are divided into those related to mineral metals, regulated by the Legislative Decree (LD) 210/1973 (OGG 1973) 'On the Mining Code', with the amendment of Law 274/1976 (OGG 1976) 'On amendment of mining code', and, second, into those that are related to the mineral stones which are regulated by Law 1428/1984 (OGG 1984) 'Exploitation of aggregate quarries and other provisions' and the amendment of Law 2125/1993 (OGG 1993) 'Amendment, replacement and supplementation of provisions of Law 1428/1984 "Exploitation of aggregate quarries and other provisions"'. These were amended by Law 4512/2018 (OGG 2018b) 'Regulations for the implementation of the structural reforms of the economic adjustment program and other provisions'.

Law 4512/2018 takes into consideration the relationship between mining activities with other land uses, and sets criteria for the establishment of mining units, determining the minimum distances from residential areas, Renewable Energy Sources (RES), Business Parks, agricultural and aquaculture areas. On islands, where good quality mineral materials that could contribute positively to the local economy are located, the determined distance from residential areas is modified as appropriate. With regard to the relationship between mining activities and landscape issues, there is an indirect reference to the obligation for rehabilitation of abandoned mining units in Article 55 (OGG 2018b).

The overall approach of this new National Policy aims to implement practices that reduce the negative effects of mining activities on human health and the natural environment and to strengthen national and local economy. It also recognizes the importance of ensuring synergies between mining activities and other sectoral policies, where possible (Tzeferis 2013).

In this paper, the visual impact of the mining units in the Cyclades is mapped with a viewshed analysis to quantify the impact of mining units on terrestrial and coastal/marine landscapes. The visual impacts on settlements are also mapped with special emphasis on nominated traditional settlements of the islands. Through this analysis, the paper aims to demonstrate, on the one hand, the pressure of the active mining units in the vulnerable landscape of islands, and on the other hand, the positive effect that the inactive mining units could have – as a part of cultural and industrial heritage – if they had proper protection and management. The inabilities of Greek spatial planning and the need for improvement are acknowledged. Likewise, the integration of landscape issues and issues with a particularly intense spatial footprint, such as mining activity, in country's spatial planning are highlighted.

2. Material and methods

2.1. Method

2.1.1. Visibility analysis

We use viewshed analysis, which is a quantitative method of calculating visibility in each landscape. It is considered a particularly suitable method for studies concerning the impact of mining units and structures on the landscape (Matias and Panagopoulos 2005; Mavrommatis and Menegaki 2017; Menegaki and Kaliampakos 2012; Mouflis et al. 2008). Typically, the location of observers and terrain are required. Here, the targets are mining units and structures, while observers do not have a specific position, but they can potentially be in each pixel of the terrestrial and marine space, thus observers and targets were reversed so that the method could be applied, considering that if the observer sees the target, the target could see the observer, too. The mining units and structures are digitalized as polygons, but, as the viewshed analysis requires points, only one point had to be selected from each polygon, the highest point of which was selected according to the contours of the terrain.

The terrain and the coordinates of observers determine the visibility result, but there are also some main variables affecting the visibility map that have to be defined, which are: (i) the observers' height is defined as 1 m, taking into account that the highest point of the polygon that identifies it has already been used; (ii) the targets' height that is defined as 1.75 m that is considered as the average human height, (iii) the maximum visibility radius that is defined as the maximum human eye viability, which depends on many factors such as the size of the structure, the colour, the contrast with the surrounding environment and the clarity of the atmosphere (Bishop 2002). The climatic conditions on Cyclades offer a clear atmosphere that allows visibility over long distances. Even in this case, there are very few people who can see a structure in the landscape that is 10 km away; most people can see structures up to 5–7 km away. The active mining units are large trenches in the landscape, which are accompanied by structures such as buildings, facilities, roads, etc., and which create an even more intense spatial footprint, both disrupting the landscape continuity and causing intense visual impact (Photo 1(i,ii)). Based on this, the maximum visibility radius was set at 8 km, considering that at this distance, the human eye can see the landscape, but without being able to discern details (Menegaki and Kaliampakos 2012). Inactive mining units are of smaller size, and the structure has been subjected to attrition and is not as distinct in the landscape as those that are active today (Photo 1(iii,iv)). Based on this, the visibility radius was set at 5 km.

2.1.2. Criteria for categorizing mining units based on their visual impact on the landscape

In this study, it has been considered that not all the active mining units exert the same pressure on the landscape, and it was deemed appropriate to be categorized based on specific criteria (Table 1). The inactive mining units were excluded from this classification, as the remaining structures were considered that they do not exert any visual pressure on the landscape; on the contrary, they are considered as part of the industrial heritage.

2.1.3. Viewshed analysis for each mining category

According to the aforementioned criteria, the mining units were categorized in four categories based on their visual impact on the landscape (Table 2).

For each of the four categories of mining units and for the mining units that are considered industrial heritage (Table 2), viewshed analysis was applied and the terrestrial and marine areas of islands that have a view of them were determined quantitatively. In order

Photo 1. Examples of mining activity in Cyclades islands. (i) Active mining unit of aggregate products in Sifnos island. Terrestrial shooting location, (ii) active mining unit of industrial minerals in Kimolos island. Marine shooting location, (iii) Ruins of the loading ladder and the administration buildings of the inactive mining unit of ores products in Sifnos island. Terrestrial shooting location, (iv) Ruins of the loading ladder of the inactive mining unit of ores products in Milos island. Marine shooting location. Source: Authors' file.

for the marine area to be determined, a maximum radius of visibility of the human eye was taken into consideration, which for the present study was considered to be 8 km. Thus, a buffer zone of 8 km was created from the coastline to the sea. The understudy marine area occupies 13,729 km². In order for the visual impact of the Cyclades residential area to be determined, which concerns both traditional and non-traditional settlements, overlay mapping was applied between the map of viewshed analysis and the map that contains the official delineation of Cyclades settlements. In the case of areas either in terrestrial or in marine space that have visibility in more than one category of Table 2, it is considered that the category with the most intense visual impact prevails, whereas in the case of areas that have visibility both in one of the categories (i), (ii), (iii) or (iv) and the category (v) (Table 2) is considered as a separate category.

2.2. Scale

In this study, the data that have been used are of vector or raster structure, and the coordinate reference system is taken from the Greek Geodetic Reference System 1987 –

Table 1. Criteria for categorizing mining units based on visual impact on the landscape.

Criteria	Description
Mining unit size	The larger the footprint of the mining units in the landscape, the more intense the pressure is exerted. The mining units were separated based on the area that they occupy. The area of the polygons of mining units was calculated; the mining units that occupy area 100,000 m^2 or more are 25
Mine support structures	This criterion concerns the facilities and support buildings that are within the mining unit as well the infrastructure, mainly roads, which only serve the mining unit and usually cover a significant altitude difference, thus creating embankments that disrupt the landscape continuity. In order for them to be located, the Google Earth was used with the auxiliary tools of Photos layer and Street View, where they were available. It was found that there are 38 mining units accompanied by support structures
Sea proximity	This criterion is about the proximity of the mining units to the sea. The proximity was determined by a buffer zone of 350 m from the coastline (OGG 2009). The coastal area is a very fragile zone, with various highly competitive land uses, and is of particular importance for tourism. It was found that 9 mining units are located to sea proximity

Source: Authors' analysis

GGRS87. Both the delineation of settlements and that of mining units have been constructed in scale 1:5000, with base map the orthophoto maps that were provided by the National Cadastre and Mapping Agency (NCMA 2020). This is a typical spatial planning scale that serves the research questions of this study. Concerning the terrain, the European Union Digital Elevation Model version 1.1 (EU DEM v1.1) has been used (EEA 2016), which has 25 m resolution and has been altered to 20 m resolution by resampling process and has been projected again from the coordinate reference system Lambert Azimuthal Equal-Area (LAEA) to the GGRS87.

2.3. Data

The delineation of official settlements was not available in digital format, and it was considered necessary to construct them in order for the impact on the visibility of

Table 2. Categories of mining units based on their visual impact on the landscape.

Categories	Description
(i) Very mild	Mining units that are included in this category have the mildest impact on the landscape since they have small size; they haven't extensive support structures and they aren't in sea proximity according to the criteria of Table 1. In this category, 11 mining units are included
(ii) Mild	Mining units that are included in this category have quite mild impact on the landscape since they meet only one of the criteria of Table 1. In this category, 14 mining units are included, most of them occupy big areas compared to the small islands' size or they have extensive support structures according to Table 1
(iii) Intense	Mining units that are included in this category have intense impact on the landscape since they meet two of the criteria of Table 1. In this category, 17 mining units are included, most of them have both big size and extensive support structures. Some of them, although they have small size, they are in sea proximity which exerts pressure on the landscape too, according to Table 1
(iv) Very intense	Mining units that are included in this category have the most intense impact on the landscape since they meet all the criteria of Table 1. In this category, 8 mining units are included that have both big size and extensive support structures, but they are also in sea proximity
(v) Industrial heritage	The mining sector that was developed in the nineteenth and twentieth centuries created a network of mining structures that left indelible footprints in the landscape. They are part of the industrial heritage of the Cyclades and the whole country and, although there has not been the necessary care and management, they give a special value to the landscape. In the study area, there have been located 32 inactive mining units and structures

Source: Authors' analysis.

mining units in the terrestrial and marine landscape, especially that of the landscape view from the settlements, to be quantified. The OGGs that contain the diagrams of the official delineation were obtained in a hard-copy (the only disposable), and they were geo-referred to GGRS87 with base map the orthophoto maps that were provided by the National Cadastre and Mapping Agency (NCMA 2020). When the delineation of the settlements were digitized (Figure 2), it became clear that the delineation of the official settlements does not correspond to the compact built-up area. The settlements were grouped into traditional and non-traditional settlements (OGG 1978, 1988). However, there are nominated traditional settlements without official settlement's delineation; in this case, the delineation was digitized based on the compact built-up area of the traditional settlement. On Cyclades, there are 221 settlements with official delineation, of which 107 are nominated traditional settlements, while 61 traditional settlements were not officially delineated. Thus, the total understudy settlements are 282, 62.9 km² in total, of which 168 are traditional settlements, which are of 36 km², and 114 are non-traditional settlements, which are of 26.9 km².

The active mining units were retrieved from the geoportal LATOMET of the General Directorate of Mineral Raw Materials of MEE as shape file and they were completed according to the interactive map of LATOMET (MEE 2018, 2020) (Figure 3). According to geoportal LATOMET, there are 50 active mining units on Cyclades, whereas the inactive mining units and remaining structures were located and digitized based on the information acquired from the book *Mines in the Aegean Sea, industrial archaeology in Greece* (Belavillas and Papastefanaki 2009), which describes and shows images of mines in the wider area in the nineteenth and the twentieth century. There were no coordinates of the location of mines but only reference to nearby villages and place names. Thirty-two (32) inactive mines were located and digitized with base map the orthophoto maps that were provided by the NCMA. The digitalization is about inactive mines and remaining structures that were detected via Google Earth.

3. Results

3.1. The visual impact of mining activities on the landscape of Cyclades

The application of viewshed analysis (Figure 4, Table 3) for the visual impact of mining units on the terrestrial and marine area of the islands show that 15.2% of the total terrestrial area has visibility of some of the categories of active mining units (Table 2). More specifically, 33.1 km², that is, 1.3% of the total area has visibility of mining units with very mild visual impact; 86.3 km², that is, 3.3% of the area has visibility of mining units with mild visual impact; 185.4 km², that is 7.2% of the total area (the highest percentage of all categories) has visibility of mining units with the intense visual impact. It is obvious that an important part of the terrestrial landscape of the islands is affected by intense visual impact from mining units. 74.1 km², that is, 2.9% of the terrestrial area has very visibility of mining units with intense visual impact. As far as the inactive mining units and structures are concerned, 67.3 km², that is, 2.6% of the terrestrial area has visibility of them. Here, visibility of industrial heritage is considered to assign special value to the landscape. In the next category (vi in Table 3), areas that have

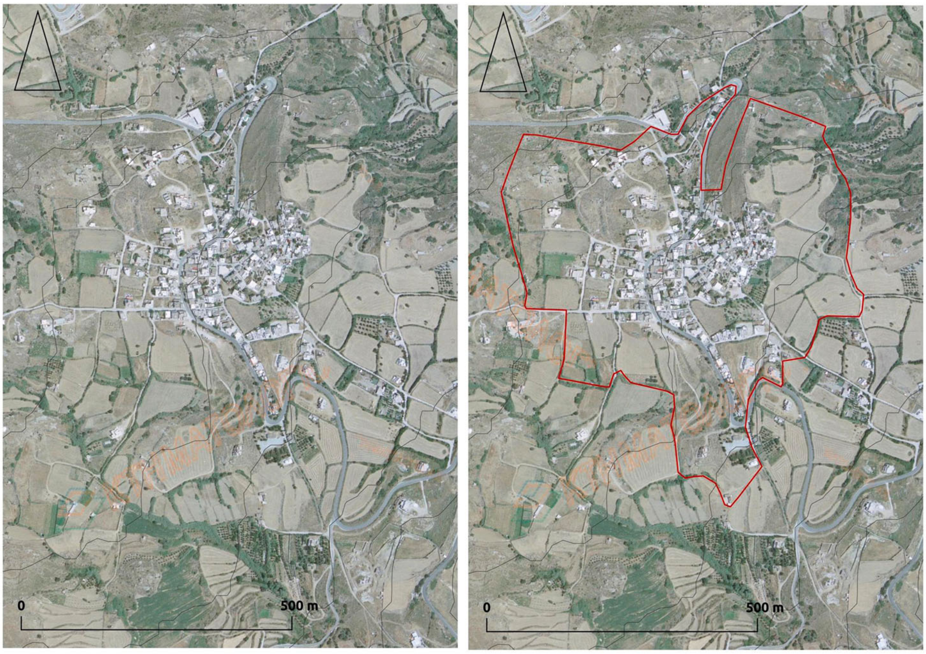

Figure 2. Built-up areas and the delineation of official settlements. Source: Authors' analysis.

Figure 3. Active mining units. Source: Authors' analysis.

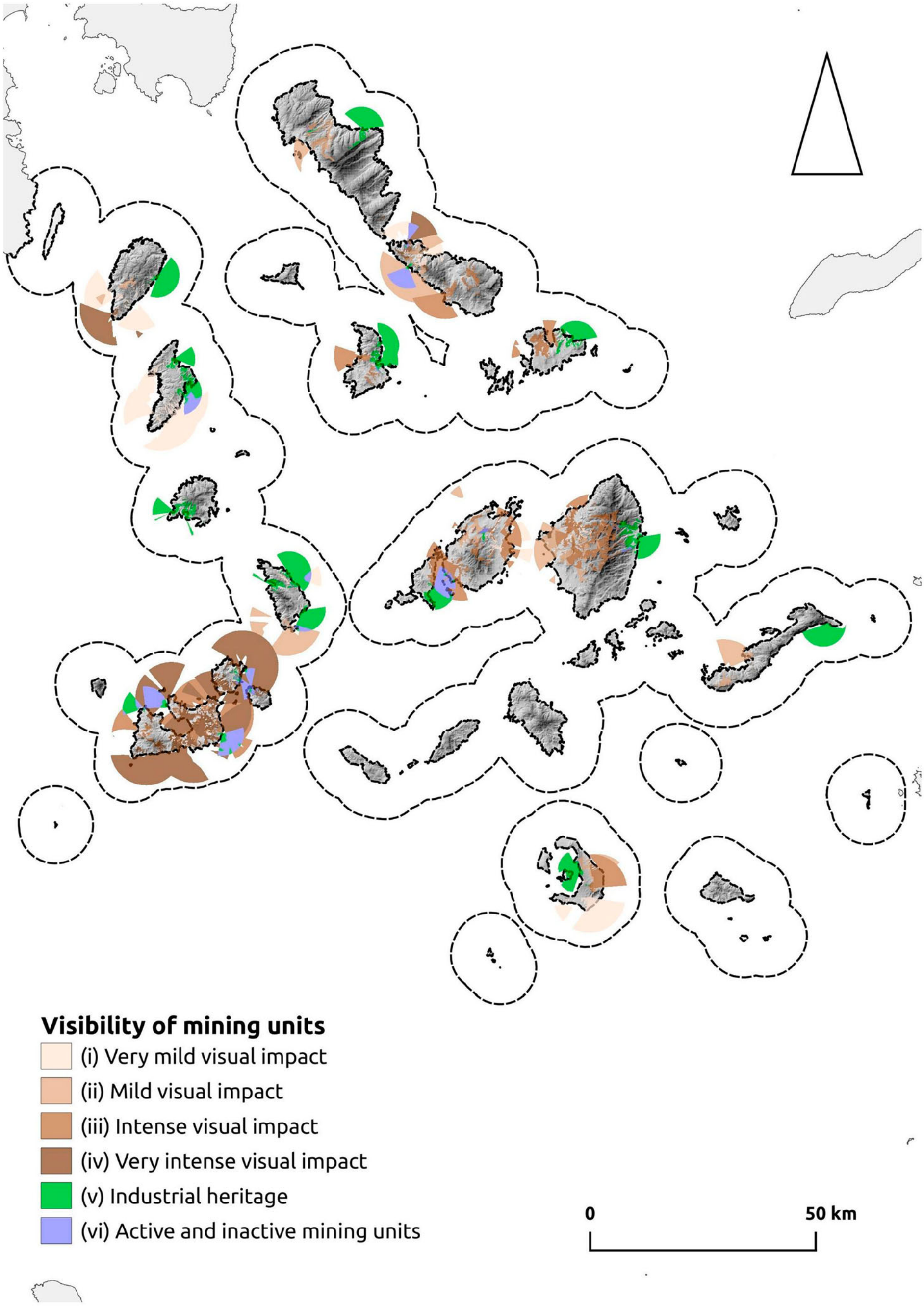

Figure 4. Terrestrial and marine visibility of mining units. Source: Authors' analysis.

visibility of both active and inactive mining units or structures are included, typically areas where mining continues, for example, on North Tinos. This category occupies 12.6 km², or 0.5% of the total terrestrial area.

Table 3. Terrestrial and marine visibility of mining units.

Categories[a]	Terrestrial area		Marine area	
	km^2	%[b]	km^2	%[c]
(i)	33.1	1.3	279.9	2
(ii)	86.3	3.3	193.4	1.4
(iii)	185.4	7.2	209.9	1.5
(iv)	74.1	2.9	435.2	3.17
(v)	67.3	2.6	319.7	2.3
(vi)[d]	12.6	0.5	108.3	0.8

[a]Categories correspond to table 2.
[b]Percentage of the total terrestrial area of the islands and islets.
[c]Percentage of the total marine area (8 km from the coastline).
[d]Visibility of both active and inactive mining units.
Source: Authors' analysis.

Out of the total marine area studied in this paper, 8.9% of the total marine area has visibility to some of the categories of active mining units (Table 2). The percentage is lower compared to the terrestrial area, a fact that is justified because most of mining units are not located in coastal areas, but rather, in several cases, are located in mountainous hilly areas where the terrain does not permit the visibility. More specifically, 279.9 km^2, that is, 2% of marine area has visibility to mining units with very mild visual impact; 193.4 km^2, that is, 1.4% of the area has visibility of mining units with mild visual impact; 209.9 km^2, that is, 1.5% of the area has visibility of mining units with intense visual impact; 435.2 km^2, that is, 3.17% of the area has visibility of mining units with very intense visual impact (which is the highest percentage of all categories). This is considered as intense pressure on the valuable marine landscape, which could lead to land-use conflicts with marine uses, for example, the daily cruises around the island could affect negatively by this kind of visibility. Regarding the inactive mining units and structures, 319.7 km^2, that is, 2.3% of the marine area has visibility to them. Unlike the previous case, the visibility of marine areas to industrial heritage could lead to synergies with uses, such as the daily cruises, which can add as an extra attraction of the route. 108.3 km^2, that is, 0.8% of the marine area has visibility of both some of the active and inactive mining unit category or structure.

3.2. The visual impact of mining activity on the settlements of the Cyclades

The application of viewshed analysis for the settlements of the Cyclades (Figure 5, Table 4) have been calculated separately for traditional and non-traditional settlements: 23.1% of the total area of settlements has visibility to some of the categories of active mining units (Table 2); 24% of the area that is inside of the delineation of non-traditional settlements has visibility to some of the categories of active mining units. It is a big percentage that shows that even if the distance of the location of mining units is taken into consideration, the issues of visibility and the landscape haven't been taken into account. Up to 1.2% of the area of non-traditional settlements has visibility to mining units with very mild visual impact, 5.4% has visibility of mining units with mild visual impact; 13.3% has visibility of mining units with intense visual impact; 3.4% of the area has visibility of mining units with very intense visual impact; Concerning the inactive mining units and structures, 2.9% of the area of non-traditional settlements has

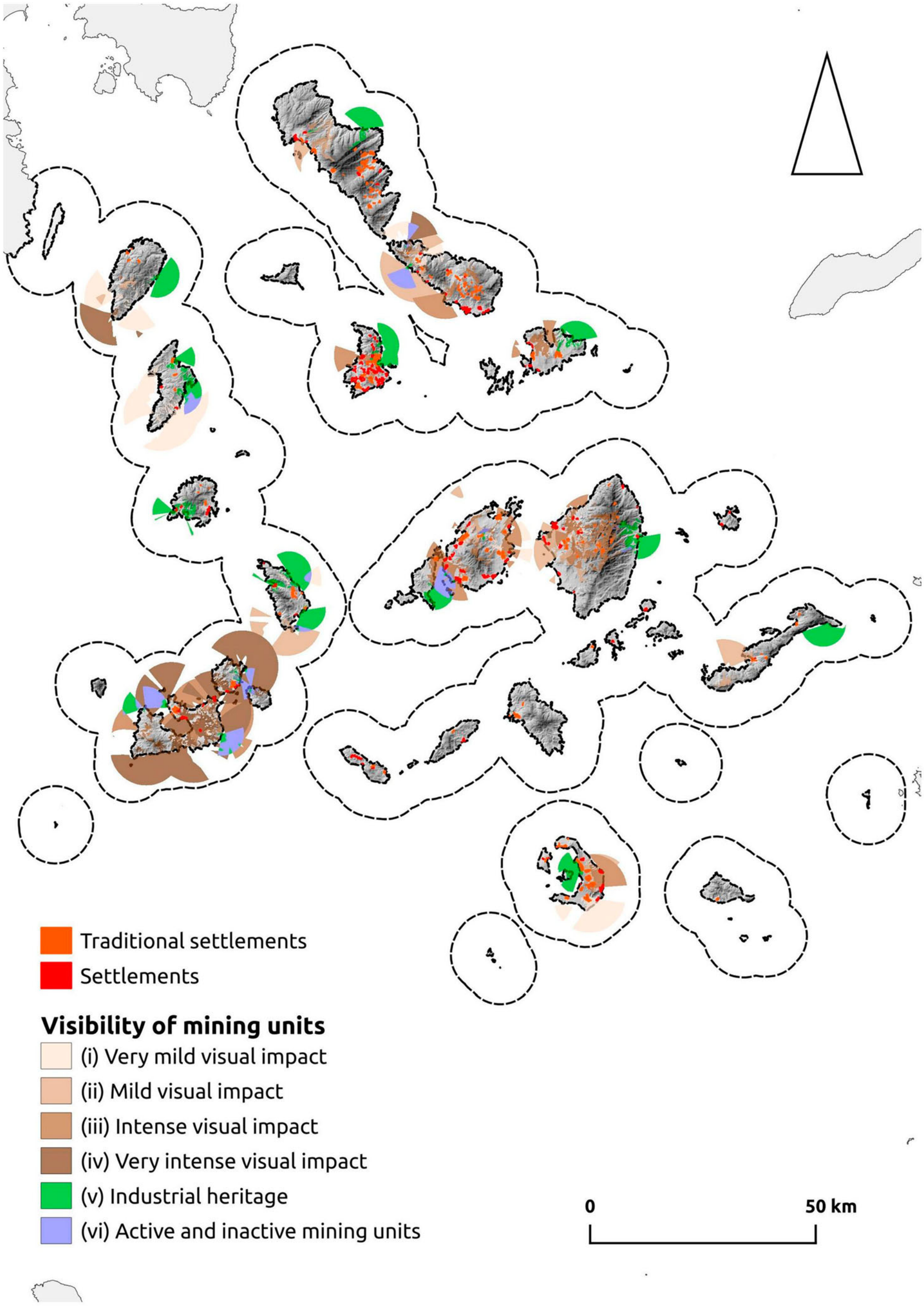

Figure 5. Visibility to mining activities of the settlements. Source: Authors' analysis.

visibility to them. If the visual industrial heritage is managed, it could both give extra value to the landscape of the settlements and be a visitor attraction. 0.7% of the area has visibility of both some of the categories of active and inactive mining unit category or structure.

Table 4. Visibility to mining activities of the settlements.

Categories[a]	Delineation of inside non-traditional settlements		Inside traditional settlements		Total	
	km²	%[b]	km²	%[c]	km²	%[d]
(i)	0.3	1.2	0.8	2.3	1.1	1.9
(ii)	1.4	5.4	2.7	7.4	4.1	6.5
(iii)	3.6	13.3	4.1	11.4	7.7	12.2
(iv)	0.9	3.4	0.3	0.8	1.2	1.9
(v)	0.8	2.9	2.2	6.1	3	4.7
(vi)	0.2	0.7	0.2	0.6	0.4	0.6

[a]Categories correspond to table 2.
[b]Percentage of the total area of settlements that are not nominated as traditional.
[c]Percentage of the total area of settlements that are nominated as traditional.
[d]Percentage of the total area of all the under study settlements.
Source: Authors' analysis.

The visibility from inside traditional settlements to some of the categories of active mining units is 22.5% of the area. There is also considered as a high percentage, especially considering that the degradation of the landscape of the traditional settlements is even more crucial. 0.8 km², that is, 2.3% of the area of traditional settlements has visibility of mining units with very mild visual impact; 2.7 km², that is, 7.4% of the area has visibility of mining units with mild visual impact; 4.1 km², that is, 11.4% of the area has visibility of mining units with intense visual impact,; 0.3 km², that is, 0.8% of the area has visibility of mining units with very intense visual impact; concerning the inactive mining units and structures, 2.2 km², that is, 6.1% of the area of traditional settlements has visibility to them. 0.2 km², that is, 0.6% of the area has visibility of both some of the categories of active and inactive mining unit category or structures.

4. Conclusions

The economy of the islands is based on the tourism sector. In recent years, it has become evident that mass tourism has been putting pressure on the socio-spatial systems of the islands, and there has been an effort to shift to alternative forms of tourism (Kapsaki, Panagiotopoulou, and Stratigea 2015; Sdrali and Chazapi 2007). A prerequisite for sustainable tourism development is the protection and sustainable management of the natural and cultural environment of the islands. Thus, the cultural heritage has to be protected and highlighted as a tourism attraction. At the same time, particular attention should be paid to the new located activities with intense spatial footprint, such as energy and communication networks, mining units, road opening etc., since they could have irreversible negative impact on the local landscape that lead to land-use conflicts and reduce its attractiveness (CEMAT 2000).

In this paper, the industrial heritage, linked with mining activity on the Cyclades, is acknowledged as a part of their cultural landscape. Nevertheless, the fact that many areas of terrestrial and marine spaces of the islands as well as settlements have visibility of mining units or structures can be considered as a landscape asset, too. With appropriate planning and management, this visibility could lead to land-use synergies and to give extra value to traditional settlements. On many islands, mining continues – although the active mining units are bigger, with different techniques of production, and causes intense pressure on the landscape leading to land-use conflict with the main sector that is tourism.

Basic requirement for land-use conflicts being avoided is the integrated spatial planning whereby the proper protection and management of the landscape will be attempted. In Greece, this has yet to be achieved, since before Law 3827/2010 (OGG 2010), the institutional framework was characterized by pluralism, since many Laws used to refer the landscape without having achieved an integrated management. The incorporation of a specific section of the landscape assessment into the revised 'Regional Frameworks on Spatial Planning and Sustainable Development' (RFSPSD) ('Perifereiaka plaisia Chorotaxikou Schediasmou kai Aeiforou Anaptyxis', in Greek), which are one for each of the 12 regions (NUTS2) is a concrete step towards the adoption of the European Landscape Convention within the spatial planning framework.

The landscape should be incorporated in the directions of national spatial planning level and subsequently, the directions to be specified in the local level. The integration of the Marine Spatial Planning in the terrestrial spatial planning would help to harmonize the goals and directions between them. However, this will not happen and so the terrestrial and marine frameworks will be different. The Marine Spatial frameworks are also important to take into consideration the marine and coastal landscape at the national, regional and local level. The method that has been applied in the present study could be a useful tool for the quantitative assessment of the landscape, and could give feedback for the terrestrial and marine spatial planning primarily at the regional and local level.

The Special Spatial Framework for Mineral Raw Materials, which is in the process of drafting the study, deal with a sector with intense spatial footprint whose impact on the landscape has extensively been presented quantitatively in this study. The results lead to the conclusion that the integration of the landscape in Special Spatial Framework for Mineral Raw Materials is mandatory. More specifically, the mining sector on the island could lead to the irreversible impact on the fragile terrestrial and marine landscape that is a key resource for sustainable development of the islands.

We consider that the viewshed analysis results demonstrate that the management of the landscape needs to be incorporated in terrestrial and marine spatial planning frameworks at various application scales, as a specific section, which will also assist the assessment of the real impacts of large-scale investments and big projects, such as mining.

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References

Antrop, M. 2005. “Why Landscapes Of the Past Are Important for the Future.” *Landscape and Urban Planning* 70 (1–2): 21–34. doi:10.1016/j.landurbplan.2003.10.002.

Belavillas, N., and L. Papastefanaki. 2009. *Mines in the Aegean Sea, Industrial Archeology in Greece*. Athens: Melissa. pp. 304.

Bishop, I. 2002. “Determination of Thresholds of Visual Impact: The Case of Wind Turbines.” *Environment and Planning B: Planning and Design* 29: 707–718. doi:10.1068/b12854.

Bürgi, M., C. Bieling, K. Hackwitz, T. Kizos, J. Lieskovsky, M. Martin, S. McCarthy, et al. 2017. “Processes and Driving Forces in Changing Cultural Landscapes Across Europe.” *Landscape Ecology* 32 (11): 2097–2112. doi:10.1007/ s10980-017-0513-z.

Cappadonia, C., P. Coratza, V. Agnesi, and S. Mauro. 2018. “Malta and Sicily Joined by Geoheritage Enhancement and Geotourism Within the Framework of Land Management and Development.” *Geosciences* 8 (7), doi:10.3390/geosciences8070253.

CEC (Commission of the European Communities). 2007. “*An Integrated Marine Policy for the European Union. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. Brussels. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:52007DC0575.

CEMAT (European Conference of Ministers responsible for Regional Planning). 2000. *Guiding Principles for Sustainable Spatial Development of the European Continent*. Hanover: CEMAT.

Charvalas, G., D. A. Solomou, D. K. Giannoulis, E. Skoufogianni, D. Bartzialis, C. Emmanouil, and N. G. Danalatos. 2021. “Determination of Heavy Metals in the Territory of Contaminated Areas of Greece and Their Restoration Through Hyperaccumulators.” *Environmental Science and Pollution Research* 28: 3858–3863. doi:0.1007/s11356-020-11920-8.

Conlin, M. V., and L. Jolliffe. 2011. *Mining Heritage and Tourism: A Global Synthesis*. London: Routledge. pp. 280. ISBN 9781138880696.

Coratza, P., R. Gauci, J. Schembri, M. Soldati, and C. Tonelli. 2016. “Bridging Natural and Cultural Values of Sites with Outstanding Scenery: Evidence from Gozo, Maltese Islands.” *Geoheritage* 8 (91): 91–103. doi:10.1007/s12371-015-0167-7.

Coratza, P., A. Ghinoi, M. Marchetti, and M. Soldati. 2019. “Geomorphology of Rio Cisles Basin (Odle Group, Dolomites, Italy).” *Journal of Maps* 15 (2): 546–554. doi:10.1080/17445647.2019.1633426.

Coratza, P., V. Vandelli, and M. Soldati. 2018. “Environmental Rehabilitation Linking Natural and Industrial Heritage: A Master Plan for Dismissed Quarry Areas in the Emilia Apennines (Italy).” *Environmental Earth Sciences* 77 (112): 1–16. doi:10.1007/s12665-018-7642-9.

Council of Europe. 2000. *European Landscape Convention*. Florence, 20.X.2000. ETS 176. Council of Europe, Strasbourg. http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm

Dal Sasso, P., M. A. Ottolino, and L. P. Caliadro. 2012. “Identification of Quarries Rehabilitation Scenarios: A Case Study Within the Metropolitan Area of Bari (Italy).” *Environmental Management* 49: 1174–1191. doi:10.1007/s00267-012-9847-0.

Dowlling, R. 2013. “Global Geotourism – An Emerging Form of Sustainable Tourism.” *Czech Journal of Tourism* 2 (2): 59–79. doi:10.2478/cjot-2013-0004.

Dowlling, R., and D. Newsome. 2018. “Geotourism: Definition, Characteristics and International Perspectives.” In *Handbook of Geotourism*, edited by R. Dowlling, and D. Newsome, 1–22. Edward Elgar Publishing. doi:10.4337/9781785368868.

EC (European Commission). 2010. *European Commission’s Guidelines for the Development of Non-energy Mining Activities in Accordance with the Requirements of the Network Natura*

2000. ["Katefthynseis tis Evropaikis epitropis schetika me tin anaptyxi mi energeiakon exoryktikon drastiriotiton symfona me tis apaitiseis tou diktyou"].

EEA (European Environmental Agency). 2016. European Digital Elevation Model (EU-DEM), version 1.1. EEA under the framework of the Copernicus program.

ELSTAT (Hellenic Statistical Authority). 2011. *2011 Population Census*. Athens: ELSTAT.

EP&C (European Parliament and of the Council). 2008. "Directive 2008/56/EC, Establishing a Framework for Community Action in the Field of Marine Environmental Policy – Marine Strategy Framework Directive." Off J Eur Union, L 164/19.

EP&C (European Parliament and of the Council). 2013. "(Proposal for a) Directive 2013/133, Establishing a Framework for Marine Spatial Planning and Integrated Coastal Management." COM(2013) 133, Brussels.

Fadda, S., M. Fiori, and C. Matzuzzi. 2010. "Developing Rehabilitation Design for the Abandoned Mine Excavations in Central Sardinia, Italy." *International Journal of Mining, Reclamation and Environment* 24 (4): 286–306. doi:10.1080/17480931003775607.

Falcucci, A., L. Maiorano, and L. Boitani. 2007. "Changes in Land-use/Land-Cover Patterns in Italy and Their Implications for Biodiversity Conservation." *Landscape Ecology* 22: 617–631. doi: 10.1007/s10980-006-9056-4.

FEIR (Foundation for Economic and Industrial Research). 2016. "The Contribution of the Mining Industry to the Greek Economy." ["I symvoli tis exoryktikis viomichanias stin elliniki oikonomia", in Greek].

Fowler, P. 2002. *World Heritage Cultural Landscape, 1992–2002: A Review and Prospects in Cultural Landscape: The challenges of Conservation*. World Heritage, Shared Legacy, Common Responsibility. Associated Workshops. Ferrara, Italy. 11–12 November 2002.

Fragkiskos, A-Z. 2009. *The Aegean, Its Islands and Their Geology in Belavillas, N. and Papastefanaki, L. Mines in the Aegean Sea, Industrial Archeology in Greece*. ["To Aigaio, ta nisia tou kai i geologia tous' sto Belavilas, N. kai Papastefanaki, L. 'Orycheia sto Aigaio, Viomichaniki archaiologia stin Ellada"] Athens. Melissa. pp. 24–29.

Geri, F., V. Amici, and D. Rocchini. 2010. "Human Activity Impact on the Heterogeneity of a Mediterranean Landscape." *Applied Geography* 30 (3): 320–379. doi:10.1016/j.apgeog.2009.10.006.

Goudouva, G., P. Loizia, V. Inglezakis, and A. Zorpas. 2018. "Quarries Environmental Footprint in the Framework of Sustainable Development: The Case Study of Milos Island." *Desalination and Water Treatment* 133: 307–314. doi:10.5004/dwt.2018.23087.

Hvizdák, L., J. Hvizdáková, M. Molokáč, and L. Molokáčová. 2012. "Mine Bankov and Mining Tourism." *Acta Geoturistica* 3 (2): 48–54.

ICOMOS (International Council on Monuments and Sites). 2008. *Declaration on the Preservation of the Spirit of the Place*. Quebec: ICOMOS.

ICOMOS (International Council on Monuments and Sites). 2014. *The Florence Declaration on Heritage and Landscape as Human Values*. Florence: ICOMOS.

Kaliampakos, D. C., and A. A. Mavrikos. 2006. "Introducing a New Aspect in Marble Quarry Rehabilitation in Greece." *Environmental Geology* 50 (3): 353–359. doi:10.1007/s00254-006-0214-4.

Kapsaki, E., M. Panagiotopoulou, and A. Stratigea. 2015. "Planning the Sustainable Tourist Development of Zakynthos Island: A Methodological Framework." Springer Proceedings and Business Economy. 1st International Conference on Cultural Tourism in a digital Era, IACuDiT 2014, Athens. Greece, 30 May 2014–1 June 2014, Code 153569. doi:10.1007/978-3-319-15859-4_30.

Kizos, T., J. Primdahl, L. S. Kristensen, and A. G. Busck. 2010. "Introduction: Landscape Change and Rural Development." *Landscape Research* 35 (6): 571–576. doi:10.1080/01426397.2010.502749.

Kizos, T., G. Tsilimigkas, and S. Karampela. 2017. "What Drives Built-up Area Expansion on Islands? Using Soil Sealing Indicators to Estimate Built-up Area Patterns on Aegean Islands, Greece." *Tijdschrift Voor Economische En Sociale Geografie* 12 (1/2017): 35–52. doi:10.1111/tesg.12244.

Kougioumoutzis, K., and A. Tiniakou. 2015. "Ecological Factors Driving Plants Diversity in the South Aegan Volcanic Arc and Other Central Aegean Islands." *Plant Ecology and Diversity* 8 (2): 173–186. doi:10.1080/17550874.2013.866989.

Lichrou, M., and L. O'malley. 2006. "Mining and Tourism: Conflicts in the Marketing of Milos Island as a Tourism Destination." *Tourism and Hospitality Planning & Development* 3 (1): 35–46. doi:10.1080/14790530600640834.

Marcucci, D. J. 2000. "Landscape History as a Planning Tool." *Landscape and Urban Planning* 49: 67–81. doi:10.1016/S0169-2046(00)00054-2.

Margiotta, S., and P. Sanso. 2017. "Abandoned Quarries and Geotourism: An Opportunity for the Salento Quarry District (Apulia, Southern Italy)." *Geoheritage* 9 (4): 463–477. doi:10.1007/s12371-016-0201-4.

Mateos, R. M., J. J. Durán, and P. A. Robledo. 2011. "Marès Quarries on the Majorcan Coast (Spain) as Geological Heritage Sites." *Geoheritage* 3 (1): 41–54. doi:10.1007/s12371-010-0026-5.

Matias, R. C., and T. Panagopoulos. 2005. "The Impact of Limestone Quarrying in Algavre Portugal." 9th International Conference on Environmental Science and technology, Rhodes, Greece. 1–3, September 2005.

Matos, J. X., A. Ferrero, S. Gatle, Z. Pereira, S. Préteseille, A. Sánchez, C. Marchán, et al. 2012. "Geological Heritage and Landscape Valorization in Mining Regions—The Atlanterra Atlantic Area Best Examples." In *Atlanterra International Congress Meeting 2012, Developing Mining Heritage, European Symposium Green-Mines. Atlanterra, Nantes*. doi:10.13140/2.1.2597.0248.

Mavrommatis, E., and M. Menegaki. 2017. "Setting Rehabilitation Priorities for Abandoned Mines of Similar Characteristics According to Their Visual Impact: The Case of Milos Island, Greece." *Journal of Sustainable Mining* 16 (3): 104–113. doi:10.1016/j.jsm.2017.10.003.

MEE (Ministry of Environment and Energy). 2018. "Open Data. Mining activity 2018." http://www.latomet.gr/ypan/StaticPage1.aspx?pagenb=16515

MEE (Ministry of Environment and Energy). 2020. "Geoportal LATOMET." http://www.latomet.gr/ypan/Default_GIS.aspx

MEECC (Ministry of Environment, Energy and Climate Change). 2019. *Hellenic Mining Industry: International Environment, Physiognomy and Prospects*. ["Elliniki exoryktiki viomichania: Diethnes perivallon, fysiognomia porooptikes", in Greek].

Menegaki, M. M., and D. C. Kaliampakos. 2012. "Evaluating Mining Landscape: A Step Forward." *Ecological Engineering* 43: 26–33. doi:10.1016/j.ecoleng.2011.02.011.

Mouflis, G., I. Gitas, S. Iliadou, and G. Mitri. 2008. "Assessment of the Visual Impact of Marble Quarry Expansion (1984–2000) on the Landscape of Thasos Island, NE Greece." *Landscape and Urban Planning* 86 (1): 92–102. doi:10.1016/j.landurbplan.2007.12.009.

National Cadastre and Mapping Agency (NCMA). 2020. *Viewing Orthophotos*. Athens: NCMA: Greek Cadastre.

Newsome, D., and R. Dowling. 2018. "Geoheritage and Geotourism." In *Geoheritage: Assessment, Protection and Management*, edited by E. Reynard, and J. Brilha, 305–321. Elsevier. doi:10.1016/B978-0-12-809531-7.00017-4.

Nita, J., and U. Myga-Piątek. 2014. "Geotourist Potential of Post-Mining Regions in Poland." *Bulletin of Geogrphy - Physical Geography Series* 7 (1): 139–156. doi:10.2478/bgeo-2014-0007.

OGG (Official Government Gazette). 1861. "On Mining." 44/24.08.1861.

OGG (Official Government Gazette). 1973. "On Mining Code." Greek Official Gazette 277/A/5-10-1973. LD 210/1973.

OGG (Official Government Gazette). 1976. "On Amendment of Mining Code." Greek Official Gazette 50/A/6-3-76.Law 274/1976.

OGG (Official Government Gazette). 1978. "Traditional Settlements Nomination of the State and Definition of Building Terms and Limitations." Official Government Gazette 594/D/13-11-1978.

OGG (Official Government Gazette). 1984. "Exploitation of Aggregate Quarries and Other Provisions." Greek Official Gazette Α΄43/11.4.1984 . Law 1428/1984.

OGG (Official Government Gazette). 1988. “Nomination of Cyclades Settlements as Traditional and Definition Special Terms and Building Restrictions.” Official Government Gazette 504/ D/14- 7-1988.
OGG (Official Government Gazette). 1989. “Nomination of Aerial Emery Transport System of Naxos as Historic Site.” Greek Official Gazette 869/B/21-11-1989.
OGG (Official Government Gazette). 1993. “Exploitation of Aggregate Quarries and Other Provisions.” Greek Official Gazette 45/A/31-3-1993. Law 2125/1993.
OGG (Official Government Gazette). 2009. “Special Framework for Spatial Planning and Sustainable Development for Tourism and Strategic Environmental Impact Assessment.” Greek Official Gazette 1138B/11.06.2009.
OGG (Official Government Gazette). 2010. “Ratification of the European Landscape Convention.” Greek Official Gazette 30-A/25.02.2010. Law 3827/2010.
OGG (Official Government Gazette). 2018a. “Incorporation into Greek Law of Directive 2014/89 / EU ‘Establishing a Framework for Maritime Spatial Planning’ and Other Provisions.” Greek Official Gazette101/A/ 12.06.2018. Law 4546/2018.
OGG (Official Government Gazette). 2018b. “Regulations for the Implementation of the Structural Reforms of the Economic Adjustment Program and Other Provisions.” Greek Official Gazette A΄5/17.01.2018. Law 4512/2018.
OJEU (Official Jurnal of the European Union). 2009. “Protocol on Integrated Coastal Zone Management in the Mediterranean.”
Parcerisas, L., J. Marull, J. Pino, E. Tello, F. Coll, and C. Basnou. 2012. “Land Use Changes, Landscape Ecology and Their Socioeconomic Driving Forces in the Spanish Mediterranean Coast (El Maresme County, 1850–2005).” *Environmental Sciences and Policy* 23: 120–132. doi:10.1016/j.envsci.2012.08.002.
Plieninger, T., H. Draux, N. Fagerholm, C. Bieling, M. Bürgi, T. Kizos, T. Kuemmerle, J. Primdahl, and P. H. Verburg. 2016. “The Driving Forces of Landscape Change in Europe: A Systematic Review of the Evidence.” *Land Use Policy* 57: 204–214. doi:10.1016/j.landusepol.2016.04.040.
Prokopiou, D., G. Mavridoglou, M. Toanoglou, and B. Tselentis. 2018. “Tourism Development of the Cyclades Islands: Economic, Social and Carrying Capacity Assessments and Consequences. Sustainable Development and Planning.” *WIT Transactions on Ecology and the Environment* 217: 509–521. doi:10.2495/SDP180451.
Reed, J., A. Ickowitz, C. Chervier, H. Djoudi, K. Moombe, M. Ros-Tonen, M. Yanou, L. Yuliani, and T. Sunderland. 2020. “Integrated Landscape Approaches in the Tropics: A Brief Stock-Take.” *Land Use Policy* 99. doi:10.1016/j.landusepol.2020.104822.
Rivera, N. M. 2020. “Is Mining an Environmental Disamenity? Evidence from Resource Extraction Site Openings.” *Environmental and Resource Economics* 75 (3): 485–528. doi:10.1007/s10640-019-00397-w.
Rutherfold, J., D. Newsome, and H. T. Kobryn. 2015. “Interpretation as a Vital Ingredient of Geotourism in Coastal Environments: The Geology of Sea Level Change, Rottnest Island, Western Australia.” *Tourism in Marine Environment* 11 (1): 55–72. doi:10.3727/154427315X14398263718475.
Sakellariou, S., F. Samara, S. Tampekis, I. Sfoungaris, and O. Christopoulou. 2016. “The Environmental Pressures and Perspectives of Tourism on Coastal and Insular Zone. The Case of Greece.” *Nature Environment and Pollution Technology* 15 (3): 1009–1020. doi:10.1093/icb/icv087.
Sdrali, D., and K. Chazapi. 2007. “Cultural Tourism in Greek Insular Community: The Residents’ Perspective.” *Tourismos* 2 (2): 61–75. ISSN: 17908418.
Selmi, L., P. Coratza, R. Gausi, and M. Soldati. 2019. “Geoheritage as a Tool for Environmental Management: A Case Study in Northern Malta (Central Mediterranean Sea).” *Resources* 8 (4): 41–48. doi:10.3390/resources8040168.
Serra, P., X. Pons, and D. Saurí. 2008. “Land-cover and Land-use Change in a Mediterranean Landscape: A Spatial Analysis of Driving Forces Integrating Biophysical and Human Factors.” *Applied Geography* 28 (3): 189–209. doi:10.1016/j.apgeog.2008.02.001.

Spilanis, I., T. Kizos, and P. Paraskevi. 2012. “Accessibility of Peripheral Regions: Evidence from Aegean Islands (Greece).” *Island Studies Journal* 7 (2): 199–214.
Tsilimigkas, G., and E.-T. Derdemezi. 2017. “‘What Do You See in the Landscape?’: Visibility Analysis in the Island Landscape of Sifnos, Greece.” *Island Studies Journal* 12 (1): 35–52. doi:10.24043/isj.4.
Tsilimigkas, G., and E.-T. Derdemezi. 2020a. “Spatial Planning and the Traditional Settlements Management: Evidence from Visibility Analysis of Traditional Settlements in Cyclades, Greece.” *Planning Practice and Research* 35 (1): 86–106. doi:10.1080/02697459.2019.1687202.
Tsilimigkas, G., and E.-T. Derdemezi. 2020b. “Unregulated Built-up Area Expansion on Santorini Island, Greece.” *European Planning Studies* 28 (9): 1790–1811. doi:10.1080/09654313.2019.1687656.
Tsilimigkas, G., and T. Kizos. 2014. “Space, Pressures and the Management of the Greek Landscape.” *Geografiska Annaler: Series B, Human Geography* 96 (2): 159–175. doi:10.1111/geob.12043.
Tsilimigkas, G., and N. Rempis. 2018. “Marine Uses, Synergies and Conflicts. Evidence from Crete Island, Greece.” *Journal of Coastal Conservation* 22 (2/2018): 235–245. doi:10.1007/s11852-017-0568-7.
Tsilimigkas, G., N. Rempis, and E.-T. Derdemezi. 2020. “Marine Zoning and Landscape Management on Crete Island, Greece.” *Journal of Coastal Conservation* 24 (43), doi:doi.org/10.1007/s11852-020-00757-5.
Tzeferis, P. G. 2013. “Greek National Policy for Exploitation of Mineral Resources. Greek Ministry of Environment, Energy and the Climate Change (YPEKA). General Secretariat for Energy and Climate Change, Mineral and Aggregate Resources Division, Athens Greece.” 6th International Conference Sustainable Development in the Minerals Industries, Milos Greece, 30 June–3 July 2013.
UNESCO (United Nations Educational, Scientific and Cultural Organisation). 1972. “Convention Concerning the Protection of the World Cultural and Natural Heritage.” Adopted by the General Conference at its Seventeenth Session, Paris, 16 November 1972.
United Nations. 1995. *The Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean*. Barcelona: United Nations Environment Programme.
Valsami- Jones, E., E. Baltatzis, E. H. Bailey, A. J. Boyce, J. L. Alexandr, A. Magganas, L. Anderson, S. Waldron, and K. V. Ragnarsdottir. 2005. “The Geochemistry of Fluids from an Active Shallow Submarine Hydrothermal System: Milos Island, Hellenic Volcanic Arc.” *Journal of Volcanology and Geothermal Research* 148 (1–2): 130–151. doi:10.1016/j.jvolgeores.2005.03.018.
Vlami, V., J. Danek, S. Zogaris, E. Gallou, I.-P. Kokkoris, G. Kehayias, and P. Dimopoulos. 2020. “Residents’ Views on Landscape and Ecosystem Services During a Wind Farm Proposal in an Island Protected Area.” *Sustainability* 12 (2442). doi:10.3390/su12062442.
Zouros, N. C. 2007. “Geomorphosite Assessment and Management in Protected Areas of Greece Case Study of the Lesvos Island – Coastal Geomorphosites.” *Geographica Helvetica* 62 (3): 169–180. doi:10.5194/gh-62-169-2007.