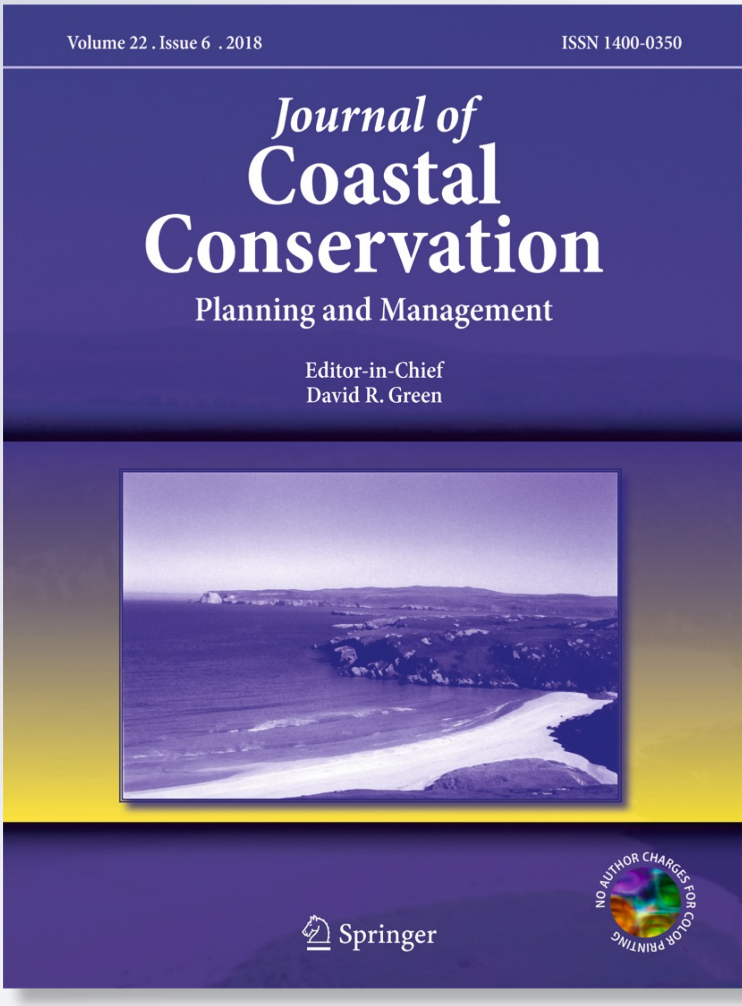
Coastal landscape and the Greek spatial planning: evidence from windpower in the South Aegean islands

Georgios Tsilimigkas, Maria Pafi & Anestis Gourgiotis

Journal of Coastal Conservation
Planning and Management

ISSN 1400-0350
Volume 22
Number 6

J Coast Conserv (2018) 22:1129-1142
DOI 10.1007/s11852-018-0620-2



Springer

Journal of Coastal Conservation (2018) 22:1129–1142
https://doi.org/10.1007/s11852-018-0620-2

Coastal landscape and the Greek spatial planning: evidence from windpower in the South Aegean islands

Georgios Tsilimigkas[1] · Maria Pafi[2] · Anestis Gourgiotis[3]

Received: 29 November 2017 / Accepted: 16 April 2018 / Published online: 24 April 2018

Abstract
This paper discusses issues about the coastal and the insular landscape integration in the Greek spatial planning framework. Case study area is the region of the South Aegean, where the proliferation of wind turbines is one of the principal factors of landscape change. The methodological approach adopted is mainly quantitative and is based on viewshed analysis. This paper is also demonstrates that zones with varying impact on landscape can be identified. It also emerges that the spatial planning framework in Greece promotes an ad hoc project-led instead of a plan-based approach to coastal and insular landscape management.

Keywords Spatial planning · Landscape · Coastal · Islands · Region of the south Aegean · Greece

Introduction

Landscape is both a physical space and its representation (Tuan 1979; Lefebvre 1991). It is not only a natural phenomenon shaped by physical structures (topography, geology, climate etc.) but also a social construction, since it projects the society on an area determined by material, spiritual, ideological and symbolic dimensions (Tuan 1979; Meinig 1979; Crumley and Marquardt 1990). It incorporates the historical development and acts as a reserve of common experience and memory defining the distinctive identity of a place (Antrop 2005; Kizos 2014), known as the "spirit" of place (ICOMOS 2008). Every landscape constitutes a cultural scene and a way of representation and symbolism of the environment through images (Terkenli 2005).

✉ Georgios Tsilimigkas
gtsil@geo.aegean.gr

Maria Pafi
mpafi01@qub.ac.uk

Anestis Gourgiotis
angourgio@protonmail.com

[1] Department of Geography, University of Aegean, University Hill, 81100 Mytilene, Greece

[2] School of Natural and Built Environment, Queen's University Belfast, David Keir Building, Belfast BT9 5AG, UK

[3] Ministry of Environment and Energy, Department of Spatial Planning, Mpiniari 20, 11744 Athens, Greece

Therefore, when new developments threaten landscapes, it is not only the material landscape, but also the immaterial aspects of it that are affected (Terkenli 2001; Stephenson 2008). This complex spatio-temporal system of tangible and intangible - human-induced practices and natural processes embodies change as an inherent process in landscape (Bürgi et al. 2004; Stewart et al. 2004; Kizos and Vlachos 2012).

As such, landscape embeds some of the major challenges facing our society, providing an area for synergies between bottom-up and top-down approaches (E.S.F. 2010). The complex and dynamic character of landscape has made conspicuous the need for transdisciplinary and multileveled studies (Crumley and Marquardt 1990; Terkenli 2001; Tress and Tress 2001; Soini 2001; Stephenson 2008; Antrop 2015). It has also made evident to policy makers that traditional approaches to landscape as a purely ecological or scenic entity are ineffective. It is clear that an integrated landscape approach has come to the forefront of both academic and policy interest (Kizos 2014; Garcia-Martin et al. 2017).

This interest is reflected most prominently in the ratification of the European Landscape Convention (ELC) by most of the member states. Defined by the 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). This definition highlights a paradigm shift, acknowledging at the same time the importance of every type of landscape "in areas of outstanding beauty as well as everyday areas" and introducing a "democratic" process for landscape assessment that is open to public participation of the civil society.

However, despite the Convention's contribution to raising the awareness of landscapes among policymakers, scientists and stakeholders, its non-binding character has undermined any substantial impact on the operational levels of landscape planning and policy (Plieninger et al. 2015).

In Greece, the belated ratification of the ELC in 2010 (Law 3827/2010) - in light of a missing landscape policy and no efficient planning framework - has further debilitated efforts to adopt an integrated landscape approach. Within the context of a generally "loose" spatial planning system driven by ad hoc procedures, spatial transformations continue to lead to significant degradation of many landscapes (Karidis 1996; Economou 2004; Tsilimigkas and Kizos 2014). In the coastal and marine realm, Marine Spatial Planning (MSP) is the most commonly endorsed management regime advocated for sustainable use of the seas. However, the concerns for social and distributive impacts of MSP (Flannery et al. 2016), and, in the case of Greece, for the complexities of its adoption, have been complicating any particular contribution to an integrated approach to coastal landscape. Urbanization, urban sprawl in rural areas, coastalization, abandonment and intensification of agriculture are considered to be the direct driving forces that reflect the most important changes in Greek landscapes (Kizos and Vlachos 2012; Kizos 2014; Chorianopoulos et al. 2014; Tsilimigkas et al. 2015, 2016).

Landscape change is more than conspicuous in coastal zones which attract a large number of people and productive activities. This intensive concentration of population and the excessive exploitation of natural resources puts high pressure on coastal ecosystems, exacerbates phenomena of coastal erosion (Jude et al. 2015; Jones et al. 2014), affects social cohesion and creates problems of congested space that quite often lead to social conflict (Thompson 2007; E.S.F. 2010; Tsilimigkas et al. 2016).

The last decade has witnessed the emergence of entirely new forms of coastal and marine uses that transform in many cases entire coastal landscapes and seascapes (Moore et al. 2017). The proliferation and location of wind turbines in coastal and marine areas generates intense public debate and subtle negotiations at the moment (Devine-Wright 2005; Batel and Devine-Wright 2015). Public opposition is based on a combination of environmental concerns but the loudest voices are of those who argue for the detrimental impacts of the wind turbines on landscapes, coastal landscapes and seascapes (Bishop and Miller 2007; Bishop 2002).

This paper seeks to contribute to the discussion about the integration of landscape into the spatial planning in light of the missing landscape policy in the Greek reality so far. It focuses particularly on the coastal region of the South Aegean where we consider that the proliferation of wind-power landscapes is among the main drivers of landscape change that significantly alter small-scale and fragile Aegean landscapes. The approach adopted here is quantitative and mainly based on viewshed analysis implemented through GIS. However, the aim is not to quantitatively analyze coastal landscape, since its complex and multi-dimensional character would require a far more elaborated and trans-disciplinary approach. Instead, we are interested in providing some initial identification of the extend and scale of coastal landscape change, and suggest that even a basic approach to landscape has yet to be considered in the Greek spatial planning framework, which has neglected landscape as a spatial unit of policy concern for so long.

Spatial planning framework and landscape policy

The consolidation of the contemporary Greek planning system can be traced back in the '90s, when a number of intense spatial, economic and social problems made evident the need for a new generation of laws (Serraos et al. 2005). Spatial issues were often more intense in coastal zones and on islands due to the population concentration and localisation of economic activities (Kiousopoulos 2008; Karampela et al. 2014; Tsilimigkas et al. 2016).

The Greek spatial planning system takes place at three levels: the national, the regional and the local within the framework of Law 2742/1999 (OGG 1999) and Law 2508/1997 (OGG 1997). These laws are partly in use today, since they have been amended by Law 4269/2014 (OGG 2014) and, subsequently, by Law 4447/2016 (OGG 2016). The latter ones are still very recent to produce any significant changes in the planning system. Therefore, they are mentioned here in order to delineate the spatial planning framework in Greece. It is not within the purpose of this paper to provide any critical analysis of them. Instead, we provide a brief description of the planning framework in order to present how the issue of coastal landscape is approached within the spatial planning framework.

Law 2742/1999 provides two types of spatial plans at the national level. The General Spatial Planning and Sustainable Development Framework (GFSP&SD) ["Geniko Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis", in Greek], (OGG 2008a), elaborates the guidelines for the organisation, management and development of the national territory in compliance with the European spatial policies. The second type of planning tools consists of spatial or sectoral directions. The sectoral spatial plans, namely the Special Frameworks for Spatial Planning and Sustainable Development (SFSP&SD) ["Eidiko Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis", in Greek], have been institutionalized for tourism (OGG 2009b), industry (OGG 2009a), renewable energy resources (OGG 2008b) and aquaculture (OGG 2011). The SFSP&SD for coastal zones and islands (MEPPPW 2003) is a typical example of framework with spatial directions that have not been institutionalized despite the significant efforts made in the early 2000s. These plans intended to specify the general guidelines, set by the GFSP&SD, on the spatial structure of main sectoral economic activities, networks and the infrastructure as well as on spatial particularities, such as coasts, islands, mountainous areas, environmental protection and critical environmental, developmental and social problem zones (Serraos et al. 2005).

At the regional level, Law 2742/1999 provides Regional Frameworks for Spatial Planning and Sustainable Development (RFSP&SD) ["Perifereiako Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis", in Greek] for the twelve regions of Greece, excluding the region of Attica. These frameworks must comply with the upper level planning, meaning the GFSP&SD and the SFSP&SD, through specification of their priorities and provision of guidelines on lower level planning.

According to the provisions of Law 2508/1997, at the Local Administrative Unit level 2 (LAU2), the General Urban Plan (GUP) ["Geniko Poleodomiko Schedio", in Greek] and the Open City Spatial and Housing Organization Plan (OCSHOP) ["Schedio Chorikis kai Oikistikis Organosis Anoichtis Polis", in Greek] are the first step to local planning and provide guidelines on spatial organization and development.

As far as Law 4269/2014 (OGG 2014) is concerned, which was subsequently replaced by Law 4447/2016 (OGG 2016), it is to alleviate the hierarchical structure of current spatial planning. Despite the fact that the detailed analysis of changes in the institutional framework goes beyond the purpose of the paper, we consider it important to focus on some key points.

Firstly, the GFSP&SD is incorporated into a general document of guidelines and principles, namely the National Spatial Strategy ["Ethniki Choriki Stratigiki", in Greek]. Furthermore, the new planning system distinguishes between strategic planning and regulatory planning. Strategic planning is implemented through the Special Spatial Frameworks (SSF), ["Eidika Chorotaxika Plaisia", in Greek] at the national level and the Regional Spatial Frameworks (RSF) ["Perifereiaka Chorotaxika Plaisia", in Greek] at the regional level. Regulatory planning is implemented through the Local Spatial Plans (LSP) ["Topika Chorika Schedia", in Greek] and the Special Spatial Plans (SSP) ["Eidika Chorika Schedia", in Greek]. Finally, the RSF acquire a regulatory character towards the lower level planning in relation to the regulation of land uses (OGG 2016).

Issues of the coastal landscape within the planning system have only been incorporated in a fragmentary manner at the regional level. At the national level, with the exception of the SFSP&SD for renewable energy sources (OGG 2008b), the other strategic plans - that is, the GFSP&SD and the SFSP&SD for tourism (OGG 2009b), industry (OGG 2009a), and aquaculture (OGG 2011) - approach the coastal landscape in a rather vague way without any further specifications. On the contrary, the SFSP&SD for renewable energy sources elaborates on some methodological landscape issues and defines specific criteria for the integration of wind turbines and solar panels into landscape (Gourgiotis and Tsilimigkas 2016). At the local level, none of the plans of Law 2508/1997 has currently incorporated landscape.

At the regional level, the institutionalized RFSP&SD did not offer specific provisions for landscape. However, the guidelines on the amendment revision of the RFSP&SD (MEECC 2010) aim to identify landscapes of particular significance in every region. This significant delay in institutionalizing the latter is due to issues related to the administrative inability to support the process and the complexity of the task in the particularly unfavorable social, economic and political crisis that Greece have been going through the last years.

It was anticipated that after their institutionalization, the revised regional plans would: (a) define general policies and guidelines for the protection, promotion and sustainable development of landscape covering the whole territory of the region; (b) identify "Landscape Zones" (LZ) concerning only outstanding or degraded landscapes. LZ are recognized and delineated based on the distinctive character of an area, after a set of natural and anthropogenic variables has been taken into consideration. Such a zone is typically defined either by a focal ecosystem (e.g. a river, a lake, a drainage basin etc.) or by the particular cultural identity that makes a landscape distinctive. Each of these LZ includes a further classification into: i) Landscapes of International Value; ii) Landscapes of National Value; iii) Landscapes of Regional Value; iv) Particularly Degraded Landscapes. This classification is based on a predefined set of criteria, the subjective judgment of the contractor of the study, the regional council and the consent of the local authority; and (c) define quality objectives for each of the LZ ensuring that new developments will comply with the aim of achieving the quality objectives. It is questionable if there will be any revised RFSP&SD under the provisions of Law 2742/1999. However, the landscape dimension will be incorporated into the RSF at the regional level again, according to the provisions of Law 4447/2016.

Although this step has been cited as a positive one towards the direction of a horizontal integration of landscape into the spatial planning system, many caveats are expected to emerge by the end of this process (Tsilimigkas and Kizos 2014). At the same time, the expert-based approach adopted reproduces a top-down procedure that fails to incorporate everyday landscapes and the public participation as proposed by the ELC (Council of Europe 2000).

Overview of the south AEGEAN region

The South Aegean region comprises of the Cyclades and Dodecanese islands and covers a marine area extending from the coasts of Attica to the south coasts of Turkey (Fig. 1). At the administrative level, it consists of 13 Provinces and 34 municipalities. The population amounts at 366.795 residents (ELSTAT 2011), which constitutes 3.35% of the total population of the country. During the last decade the population has significantly raised (21.18%), whereas at the national level there has been a decreasing tendency. Its economy is heavily based on tourism, and this is more than evident given that 21% of the total touristic accommodations of Greece are located in the South Aegean (MEECC 2015).

One of the main geographic characteristics of this region is the great number of islands −79 islands, of which 55 are inhabited (ELSTAT 2011). The total area of the islands covers 5.313 km^2 (4% of the total area of Greece), of which 28% is characterized as mountainous areas, 43% as semi-mountainous and 29% as flat areas (MEECC 2015). The extensive length of the coasts along with the fragmented geography of the islands shape coastal landscapes with unique diversity and fragile ecosystems. The Aegean landscape demonstrates important biophysical diversity, complex geomorphology and an insular geography that has historically rendered the Aegean Sea a space of communications, trade and intercultural exchange. Nevertheless, there are some features that can be considered as drawbacks, such the isolation from the mainland, the enclosure by water, limited resources and the intensive human presence which has shaped these landscapes for a long time (Terkenli 2001; Terkenli 2005; Kiousopoulos 2008; Karampela et al. 2014).

Coastal landscapes of the Aegean have for long represented the typical landscape for Greek island tourism, comprising of the triad "sea, sun and sand". These coastal landscapes now have to accommodate new controversial types of land use, for example, the proximity between the protected areas NATURA 2000 with the wind parks on the island of Rhodes (Fig. 2). Greece has committed to a renewable energy target of 20% by 2020 focusing particularly on wind farms. Within this context, the high wind power potential of the Aegean substantially expands the available portfolio of available renewables (Kaldellis and Kavadias 2004; Dimitropoulos and Kontoleon 2009). The magnitude of this potential is depicted in the planned expansion of wind turbines in the near future. More specifically, there are currently 116 functional wind turbines installed in the region, but this number is expected to raise substantially with 776 new wind turbines having been granted permission for production, which is the first stage of the installation and operation process. Thus, over-concentration of population and activities, on the one hand, and the emergent wind-power landscapes, on the other hand, have led to contested coastal landscapes with various socio-economic and environmental problems. Therefore, the question is, can the Greek spatial planning incorporate these challenges given the inefficiency of the landscape policy integration as discussed in the previous section? (Table 1).

Data

The working scale in this study is fixed at 1:100.000. Therefore, the spatial resolution of the dataset – that is, the dimension of the cell size representing the area covered on the ground - is set at 100 m. The working scale is considered (a) appropriate for the nature of the research question; (b) an appropriate scale for

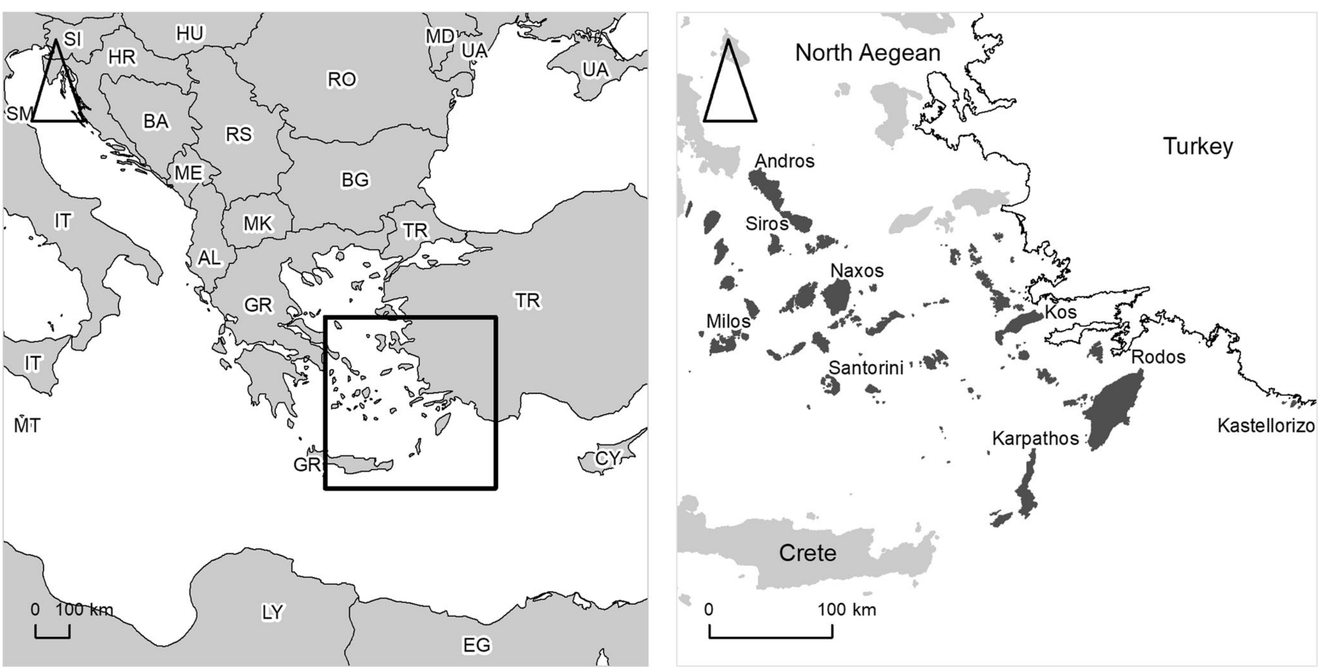


Fig. 1 Location map of the South Aegean Region. Source: © 2017 Tsilimigkas, Pafi & Gourgiotis

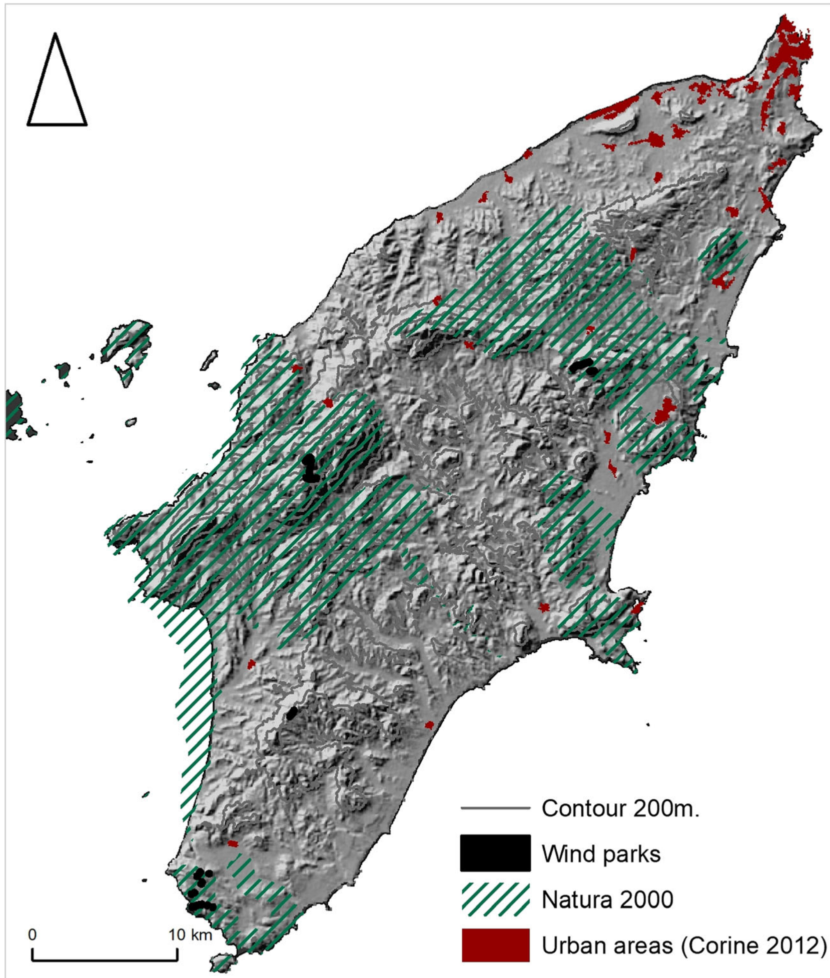


Fig. 2 The island of Rhodes. Source: © 2017 Tsilimigkas, Pafi & Gourgiotis

regional planning and (c) compatible with the data available. The datasets used in this paper are free and comprise of:

(a) The locations and geometric characteristics (tower height and rotor diameter) of the wind turbines obtained from the geoportal of the Regulatory Authority of Energy (RAE 2017). These data are available at a point vector format, and have been digitized on a topographical map at scale 1:50.000 (RAE 2017).

(b) The digital elevation model of Greece was obtained from the NASA Shuttle Radar Topography Mission (SRTM) at 90 m original spatial resolution which was resampled at 100 m. The caveat of the original dataset produced by NASA is that it contains voids in areas covered by water bodies or snow due to inherent characteristics of the satellite. For this reason we used the rectified version (Version 4) provided by the CGIAR-Consortium for Spatial Information (CGIAR-CSI) which applies

Table 1 Wind turbine characteristics

	South Aegean		Greece
	Currently installed	Granted permission for production (to be installed)	Currently installed
Number of turbines	116	776	1.969
Total capacity (MW)	95	2.013	2.494
Average capacity (MW)	0,8	2,6	1,3
Average Tower height (m)	50	84	62
Average Rotor diameter (m)	46	79	59

Regulatory Authority for Energy 2007

methods of interpolation to enhance the original dataset (CGIAR-CSI 2017).

(c) The disaggregated population grid for the year 2011 in 100 m spatial resolution provided by the European Commission, Joint Research Center (JRC). This spatial raster dataset depicts the distribution and density of residential population, expressed as the number of people per cell. Resident population from censuses for the year 2011 provided by Eurostat were disaggregated from source zones to grid cells, informed by land use and land cover from Corine Land Cover and by the distribution and density of built-up as mapped in the European Settlement Map 2016 layer (Freire et al. 2016).

Methods

Mapping of visual impacts typically relies on a combination of GIS and viewshed analysis-based methods (Daniel 2001; Bishop and Miller 2007; Tsoutsos et al. 2006; Tsoutsos et al. 2009). Viewshed analysis has been widely employed in a in a range of diverse studies, such as determining visual impact of quarries (Mouflis et al. 2008), evaluating the impact of urban sprawl on archaeological sites (Wheatley and Gillings 1999) and assessing the impact of various infrastructures (unregulated buildings, landfills etc.), being considered to negatively affect insular landscapes (Tsilimigkas and Derdemezi 2017). As shown in the literature, viewshed analysis has been applied to quantify the impact of aquaculture (Falconer et al. 2013) and, most prominently, the impact of on-shore and off-shore wind turbines on landscape (Möller 2006; Möller 2010; Depellegrin et al. 2014). Accordingly, a number of good practice guides has been developed, particularly in the UK, in an effort to systematize the methodology and provide evidence to support planning and decision making (Hill et al. 2001; NIEL 2008; NE 2012; SNH 2012; SNH 2014; SNH 2017).

Viewshed analysis determines the visibility of pixels across a surface from selected viewpoints. The visibility of each cell centre is determined by comparing the altitude angle with the cell centre and with the local horizon. The local horizon is computed by considering the intervening terrain between the point of observation and the current cell centre. If the point lies above the local horizon, it is considered visible (O'Sullivan and Turner 2001). The area over which a development can theoretically be seen is known as Zone of Theoretical Visibility (ZTV). The ZTV usually presents a 'bare ground' scenario - that is, a landscape without screening structures or vegetation (Hill et al. 2001; SNH 2017).

Despite the wide adoption of this method, determining the visual impact through viewshed analysis imposes several limitations. It is heavily influenced by factors such as (a) slope and aspect of the terrain; (b) the distance between the object (target) and the observer; (c) the atmospheric conditions and the luminance of the atmosphere (Nutsford et al. 2015); and (d) the physical properties of the human eye (Shang and Bishop 2000). Although several researchers have explored the influence of these dimensions on visibility, there is still ambiguity as to the exact thresholds to be used in viewshed analysis. For example, Bishop and Miller (2007) and Bishop (2002) have tested a combination of distance cut-offs (4, 8 and 12 km.) and atmospheric conditions to determine the visual impact of wind turbines. They argue that the contrast in colours is as important a predictor of visual impact as is the distance. Interestingly, the more the distance between the observer and the target increases the more important contrast tends to become. However, these results significantly vary when it comes to offshore wind turbines, where, due to their size and their contrast with the sky, their visual impact can extend to 30 km (Bishop 2002; SNH 2012; SNH 2014).

The methodology adopted here is developed at three stages. The first stage involves the identification of the Zones of Theoretical Visibility (ZTV), meaning the zones with visual contact with wind turbines. This layer is produced using viewshed analysis and is presented in a binary format (visibility-no visibility). To understand this approach, we can imagine a headlight illuminating portions of a landscape. As the headlight revolves around a viewer's position in the illuminated areas, connected sites can be visually identified. Shadowed areas identify locations that cannot be seen by the viewer, and the result is a viewshed map (Tsilimigkas and Derdemezi 2017). A typical viewshed map requires entities that act as 'targets' and entities that act as 'observers'. The observers are those entities we are interested in as to how they determine what they see. Here, we are interested in the visual contact of the whole area of the islands with wind turbines. Therefore, 'observers' and 'targets' are reversed with the rationale that if an observer can see a wind turbine, then the wind turbine can also "see" the observer. This reversion allows the results to be presented in a continuous grid with geographic coverage of the whole territory of the region.

To calculate the ZTV, we set the wind turbines as 'observers', with an offset of 50 m each, which is the average height of the tower of a wind turbine in the South Aegean region. Another critical parameter, apart from the height of the observer, is the radius around which this object can "see" or be seen. Since there is no global threshold established for this parameter, we use empirical evidence as adopted by the guidelines on good practice (NE 2012; SNH 2012; SNH 2014). For heights of turbines up to 50 m, it is less possible to identify the tower at distances over 10 km. However, blade movement can be detected up to 15 km in clear conditions, or where there is a strong contrast between the rotors and the sky. In the same train of thought, visibility of a 51–70 m, turbine cannot extend beyond 20 km, while the maximum distance threshold is set to 35 km for turbines exceeding the height of

100 m (usually the size of an offshore wind turbine) (SNH 2017). Given the average tower height of 50 m in the case study, we adopt a 10 km radius to delimit visibility, acknowledging that this distance can extend slightly further under specific conditions.

Subsequently, we set all the pixels of the region as 'targets', using as elevation model the SRTM Digital Elevation Model. The target's offset is set at 2 m instead of 1.5 m which is often the case for a viewer on the ground as relating to the average viewer's eyes (or a camera). The rationale behind this selection is related to the error of vertical dimension inherent in the Digital Elevation Model (usually 1.5–2 m) (SNH 2017). Therefore, we use the maximum of 2 m as the viewer height to mitigate this caveat. As for the rest of the parameters of the viewshed analysis, we use a 360 degrees viewing angle, since we are interested in panoramic views, and we also include the refraction coefficient for light and the height correction for the earth's curvature as recommended by the SNH (2017).

The second stage includes the classification of the ZTV in Zones of Visual Impact (ZVI), acknowledging that a ZTV alone is not able to convey the nature or magnitude of visual impacts. For example, whether visibility will result in positive or negative effects and whether these will be significant or not requires a different approach. Typically, the impact assessment stage is a professional and methodical process by which a proposed development is assessed based on a Landscape Character Assessment (LCA) and enhanced with field research and uses surveys to capture individuals' perceptions. However, for the purposes of this study, we adopt a simplistic approach hypothesizing that distance is the main parameter that determines the significance of the visual impact.

Within this context, we use the thresholds proposed by Bishop and Miller (2007) to determine three landscape zones, namely the immediate zone (less than 4 km), the intermediate zone (4–8 km) and the distant zone (more than 8 km) (Diagram 1). Another issue to be addressed here is the point from which these distances are calculated. While the viewshed analysis uses the locations of the individual wind turbine as input, the definition of landscape zones does not require the individual turbine but rather the clusters of the turbines that shape entire wind-power landscapes. This topic has not been adequately addressed in the literature.

Therefore, we used the definition adopted in the Ministerial Decision no. 13310 (MD 2017) on how to proceed and issue permissions for the installation and operation of power stations with the use of Renewable Energy Resources ["Diadikasia ekdosis adeion egkatastasis kai leitourgias stathmon paragogis ilektrikis energeias me chrisi ananeosimon pigon energeias", in Greek]. In this decision, the clusters of wind turbines and the installation space allocated to them, defined as "wind parks", are delineated by the outer line which includes the circles whose centre is the locations of the towers of the turbines and a radius equal to 3.5D, where D is the diameter of the rotor (MD 2017). Consequently, we use the average diameter of the rotor which is 46 m (RAE 2017) multiplied by 3.5 which equals to a radius of 161 m. In this way we define wind turbine clusters out of which the landscape zones are calculated (Diagram 2). Finally, we overlay the ZTV with landscape zones to obtain the ZVI as follows: a) the ZTV that overlap with the immediate landscape zones are multiplied by 3 and in a categorical scale they are characterized as Zones of High Visual Impact; b) the ZTV that overlap with the intermediate landscape zones are multiplied by 2 and in a categorical scale they are characterized as Zones of Medium Visual Impact; and c) the ZTV that overlap with the distant landscape zones are multiplied by 1 and in a categorical scale they are characterized as Zones of Low Visual Impact.

The third stage includes the calculation of areas and populations per island that are exposed to potential visual impacts. Calculating the areas is quite straightforward. For the affected population we use the disaggregated layer provided by the JRC which we overlay with the ZVI using zonal statistics functions. For each of the ZVI the values of the pixels of the ESM that fall within it are summarized to obtain the total density which is then translated into absolute population numbers.

Despite the growing use of viewshed analysis as a method to determine the impact of specific developments on landscape, it still remains insufficient to understand the complex and multidimensional character of landscape (Ervin and Steinitz 2003; Kizos 2008; Tsilimigkas and Kizos 2014). In

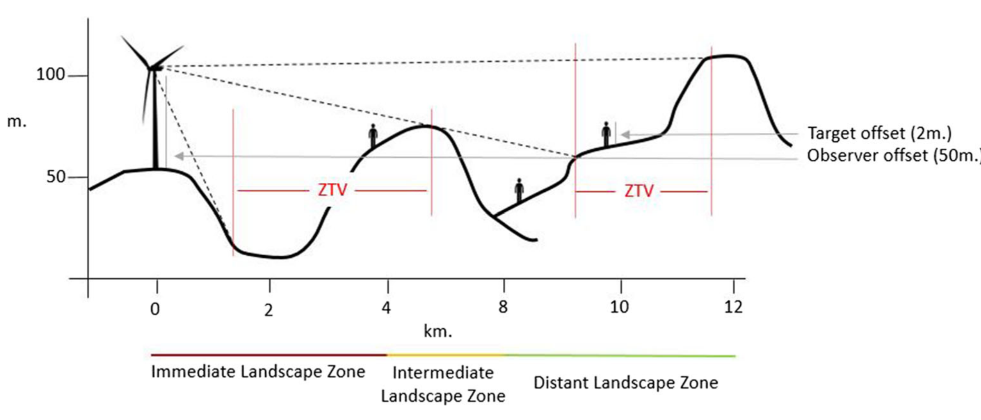


Diagram 1 Depiction of the ZTV and landscape zones. Source: © 2017 Tsilimigkas, Pafi & Gourgiotis

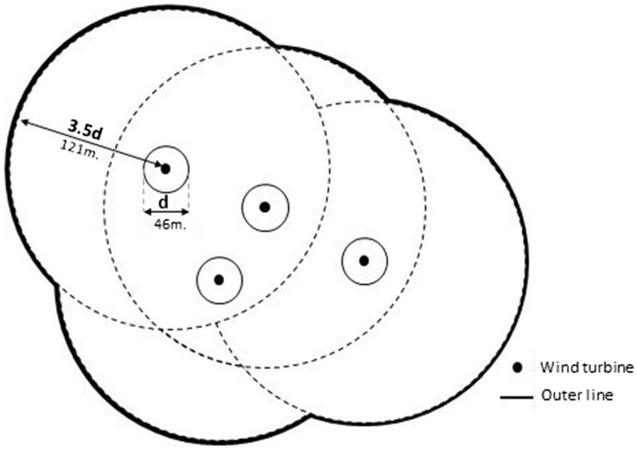


Diagram 2 Schematic depiction of wind turbine clusters. Source: © 2017 Tsilimigkas, Pafi & Gourgiotis

such data-driven models which adopt the concept of a Cartesian space, the immaterial dimensions of landscape are particularly neglected. Therefore, we acknowledge that viewshed analysis in itself cannot capture the complexity of landscape or become a solid basis to inform landscape policy and planning. However, what is adopted here as the first level of understanding is the magnitude of the impact of such installations on the Aegean islands and, therefore, as a way to open the discussion about wind-power landscapes in general. Finally, we attempt to highlight the inefficiency of the Greek spatial planning to incorporate any valuable tools to guide decision making on landscape issues.

Results

The viewshed analysis results only concern the 14 islands with installed wind turbines in the South Aegean region. Figure 3 depicts the Zones of Theoretical Visibility (ZTV), the Zones of Visual Impact (ZVI) and the distribution of population in them on the island of Rhodes. Although the ZTV expands also at the marine space, the calculation of the ZVI only concerns the terrestrial space where there is population data.

At the regional level, areas with visual contact with wind turbines cover 27% of the total area of the region. The population exposed to visual contact with wind-power landscapes represents 18% of the total population of the region (Table 2). A breakdown of these values at the island level can be seen in Table 3, where the coastal areas with visual contact to wind turbines (ZTV) and the population located within these areas are presented. The average area with visual contact to wind-power coastal landscapes is 103,85 km^2, while the average population exposed amounts to 4.600 inhabitants. Rhodes, Kos and Syros are the three islands which are mostly affected as regards visual contact to wind-power landscapes. Particularly, Siros-Ermoupoli has the highest population affected while the corresponding ZTV is significantly smaller in comparison with Kos and Rodos (Diagram 3).

The classification of the ZTV area into Zones of Visual Impacts (ZVI) and the calculation of the population within these zones (Table 4) indicate that almost half of the total population that is exposed to visual contact with wind turbines is located into zones of high visual impact. Syros, again, demonstrates a particularity since 84% of the affected population is located within the zone of high visual impact, indicating the proximity of the wind turbines to densely inhabited areas. This could be a rough indicator of an inappropriate siting of wind-turbines in the island of Syros.

Such indicators could be useful during the decision-making process so that the visual impact on coastal landscapes and people is eliminated by optimising the installation of the wind turbines. It could substantially enhance the current ad hoc project-led permission process towards a more strategical plan-based one. Such zones, provided that the analysis takes place at working scape of 1:20.000, could be utilised at the local level of planning in order to guide investments to particular areas with small visual impact. However, the current spatial planning framework lacks the capability of incorporating such findings due to the absence of an overarching landscape policy.

Discussion

Landscape has been recognized in Law as a heritage asset since 1950 (OGG 1950). However, few policies and projects have been implemented landscape management and protection since then (Tsilimigkas and Kizos 2014). The ratification of the ELC in the national legislation (Law 3827/2010) is the first step for an integrated and coherent Landscape Policy which will embody four key principles interwoven with the complex system of interrelations and interactions of landscape. These key principles presented below are based on: (a) the European Landscape Convention (Council of Europe 2000); (b) the Guidelines on the Implementation of the European Landscape Convention (Committee of Ministers 2008), which set out a series of theoretical, methodological and practical guidelines for the implementation of the ELC at the national level; (c) the ratification of the ELC as transposed to the Greek legislation through Law 3827/2010; and (d) a number of landscape approaches of good practice at the international level.

1. The delineation of the spatial area of landscape study must incorporate both, the principle of topological continuity and the "democratization" of landscape protection. The ELC focuses on territory interpretation as a whole without distinguishing between the urban, peri-urban, rural and natural, or between those landscapes regarded as outstanding. Instead, it includes the everyday and degraded

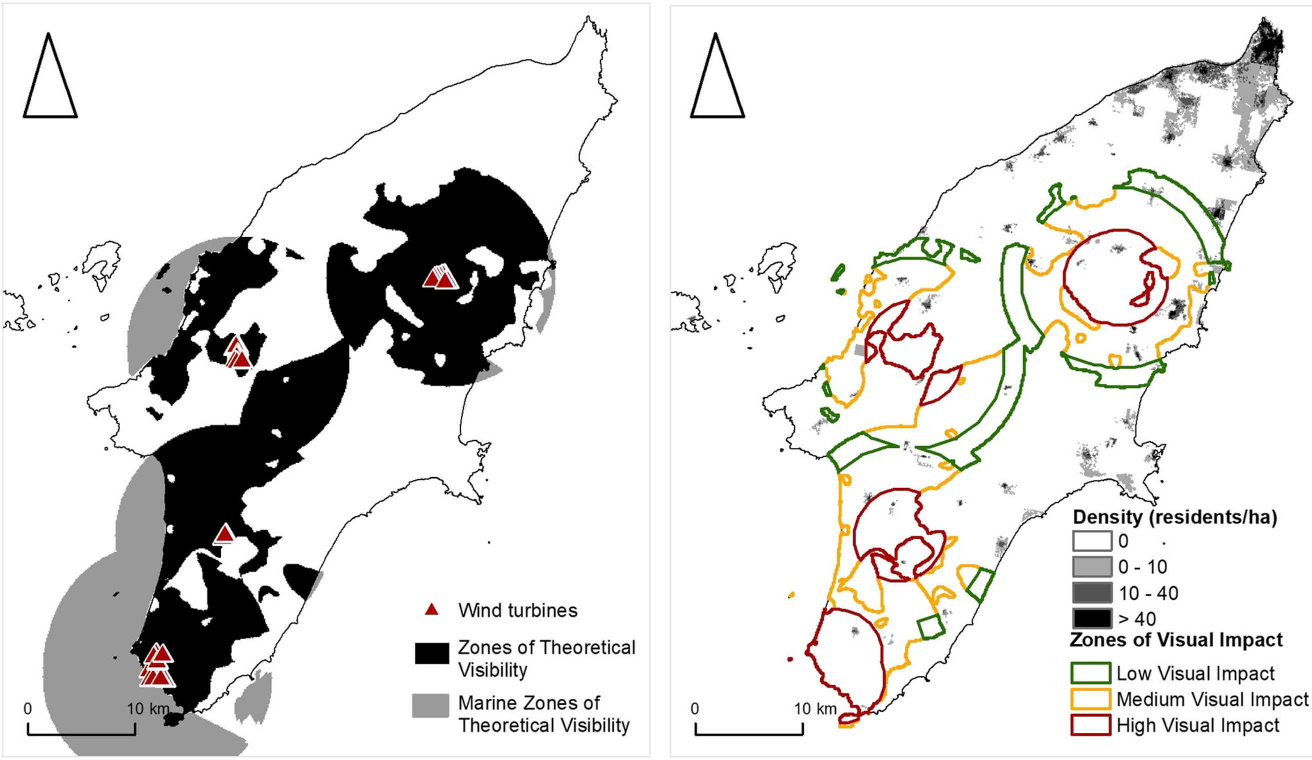


Fig. 3 Rhodes island (**a**) Zones of Theoretical Visibility (ZTV); (**b**) Population density and Zones of Visual Impacts (ZVI). Source: © 2017 Tsilimigkas, Pafi & Gourgiotis

landscapes and covers land, sea and inland waters (Council of Europe 2000). The concept of landscape in the convention diverts from the one that sees landscape as an "asset" (heritage concept of landscape) and is typically focused exclusively on the "outstanding" landscapes. This new concept confronts the theme of the quality of the surroundings where people live, which are required for individual and social well-being (understood in the physical, physiological and psychological sense). It also stresses the importance of landscape as a resource conducive to economic activity (Committee of Ministers 2008). Therefore, the physical-geographical and socio-economic dimensions of landscape in space and time must be articulated through specific and comprehensive priorities both in spatial, sectoral and in development policies.

2. The multi-faceted and dynamic character of landscape means that landscape changes in time, and so does the relative data. The effective confrontation of the multidimensionality of landscape can only be achieved through inter- and trans-disciplinary studies. In this sense, the landscape policy must inherently adopt mechanisms for adaptation, monitoring and evaluation. The composition of a Landscape Observatory seems to be an indicated solution towards this direction (Tsilimigkas and Kizos 2014). A good example is the Landscape Observatory of Catalonia, where they put together an advisory body to produce landscape studies, prepare proposals, raise the awareness of the society and systematically monitor drivers of change (annual reports on the state of landscape, monitoring of changes etc.) (Landscape Observatory 2014).
3. A major issue about landscape management is the selection of proper authorities and the administration level for the implementation of the policy, ensuring that each of these authorities has distinct responsibilities within their field of competence. Co-ordination of the actions for an effective implementation of the strategy must be held by a proper authority responsible for the overarching cooperation and

Table 2 Regional visibility to wind-power landscapes

	Area (km^2)	% of area	Population exposed	% of population exposed
No visibility	3859,57	73%	302.390	82%
Visibility (ZTV)	1453,91	27%	64.405	18%
Total	5313,48	100%	366.795	100%

© 2017 Tsilimigkas, Pafi & Gourgiotis

Table 3 Areas and population per island exposed to visual contact with wind-power landscapes

Island name	ZTV area (km^2)	% of total ZTV area	Population exposed	% of total population exposed
Rhodes	602.8	42%	12.145	19%
Kos	182.6	13%	12.941	20%
Naxos & Mikres Kiklades	161.8	11%	4.437	7%
Milos	70,8	5%	3.649	6%
Paros	62,1	4%	3.948	6%
Syros	59,4	4%	15.456	24%
Ios	49,3	3%	1.659	3%
Karpathos	47,6	3%	629	1%
Mikonos	47,6	3%	2.548	4%
Kythnos	44,7	3%	915	1%
Andros	44,4	3%	220	0%
Leros	30,4	2%	4.420	7%
Tinos	27,8	2%	206	0%
Patmos	15,6	1%	1.232	2%
Total:	1453,9	100%	64.405	100%

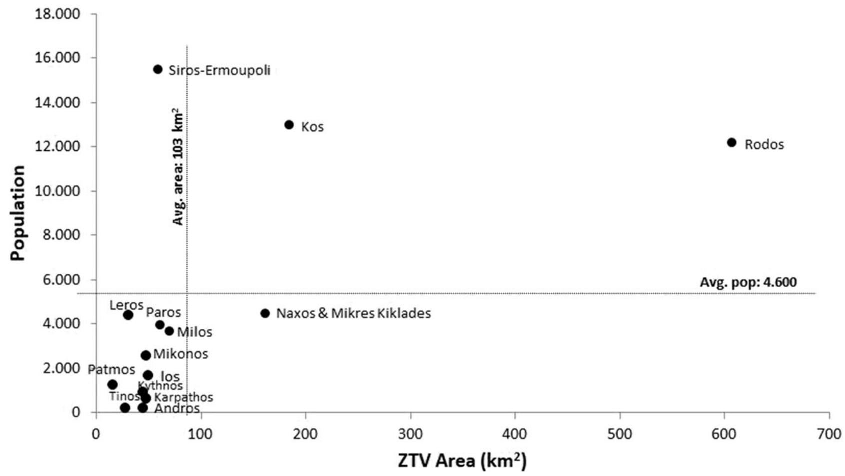
the complementarity of the policies. Landscape policy must build on a transparent national data framework which will provide the structure for on-going collection of landscape-related data from multi-disciplinary fields. Such a database must provide mechanisms for updating and collating new data, in compliance with the principles of adaptive management (EP&C 2007).

4. In order for the landscape framework to be accepted by the public and legitimized, democratic participation of the local community is the key element (Council of Europe 2000). Implementing and monitoring landscape policies should be preceded and accompanied by procedures of participation of members of the public and other relevant stakeholders, aiming to enable them to play an active role in formulating,

Table 4 Areas and population per Zone of Visual Impact (ZVI)

	Low visual impact		Medium visual impact		High visual impact	
Island name	Area (km^2)	Population	Area (km^2)	Population	Area (km^2)	Population
Rhodes	114,5	12.53	315,9	9.452	177,4	1.440
Kos	25,2	125	81,4	7.511	78,0	5.305
Naxos & Mikres Kiklades	13,1	138	80,1	1.905	68,7	2.394
Milos	17,6	58	36,3	3.591	16,9	0
Paros	11,0	90	29,8	2.991	21,3	867
Syros	0,8	0	18,7	2.495	39,9	12.961
Ios	0,0	0	10,3	77	38,9	1.582
Karpathos	2,7	0	7,9	0	37,0	629
Mikonos	0,1	8	16,7	1.459	30,8	1.081
Kythnos	2,0	0	11,6	4	31,0	911
Andros	0,0	0	5,7	12	38,7	208
Leros	0,3	0	9,5	2.056	20,6	2.365
Tinos	0,0	0	11,9	34	15,9	171
Patmos	0,5	0	5,8	1.014	9,2	218
Regional totals	187,9	1.671	641,7	32.601	624,3	30.133

Diagram 3 Scatter plot of the islands. Source: © 2017 Tsilimigkas, Pafi & Gourgiotis



implementing and monitoring landscape quality objectives (Committee of Ministers 2008). Participatory processes are typically encountered at medium and lower scales of planning and to a lesser degree at the national level, where complex organizational and managerial issues arise. Therefore, at the larger scale a framework of consultation must be ensured between governmental bodies of deconcentrated and decentralized administration bodies in order to mediate conflicting objectives of different policies. Synergies must occur whenever possible.

The aforementioned principles must be horizontally implemented in both strategic and physical spatial planning as a distinctive landscape policy covering all levels and scales of coastal and insular areas. At the national scale this framework should be formed as a strategy to set long-term objectives and actions with regard to landscape, covering as whole coastal and insular areas from a perspective that covers both the terrestrial and marine space. The definition of landscape objectives will provide a framework for guiding future investments in a plan-based instead of a project-led approach, as has been the case mostly for coastal and insular areas for years. In doing so, it must ensure compatibility with: (a) national strategic policies as elaborated in the GFSP&SD (OGG 2008a); (b) the SFSP&SD for renewable energy sources (OGG 2008b), for tourism (OGG 2009b), industry (OGG 2009a), and aquaculture (OGG 2011); (c) regional spatial strategies as implemented by the RFSP&SD for the twelve regions of the country; (d) the economic programming as elaborated in the national development and regional operational plans Partnership Agreement for the Development Framework 2014–2020; (e) national sectoral policies as implemented by the special frameworks (industry, energy, transportation etc.); and (f) ratified European and international conventions.

Following completion of the national data framework as discussed above, a national typology of landscape could be prepared using the data base in order to identify, characterize and map the Greek landscape and provide the data and qualitative information required to evaluate its current position and underpin effective spatial planning. This typology can substantially complement the overarching strategic landscape policy and help overcome the piece-meal approach of the sectoral plans. A first step towards this direction was proposed by Tsilimigkas and Kizos (2014) who defined a national typology for Greek landscapes crossing a set of spatial criteria (land cover, coastal character, elevation and slopes). The results of any adopted national typology must be tested and evaluated through a number of case studies (Tsilimigkas et al. 2016).

At the local scales, the objectives of the coastal and the insular landscape set by the upper levels of planning must be specialized and implemented through the regulatory plans produced primarily by Law 2508/1997, or as amended by the most recent Law 4447/2016 (OGG 2016). These plans include: (a) Master Plans ["Rythmistika Schedia", in Greek] for Athens and Thessaloniki; (b) Master Plans ["Rythmistika Schedia", in Greek] provided for other cities; (c) General Urban Plans ["Geniko Poleodomiko Schedio", in Greek] and the Open City Spatial and Housing Organization Plan ["Schedio Chorikis kai Oikistikis Organosis Anoichtis Polis", in Greek]; (d) Environmental Impact Studies ["Eidikes Perivallontikes Meletes", in Greek]; (e) the Urban Development Control Zone ["Zones Oikistikou Elenchou", in Greek]; and (f) other City/town Plans or other Land Use plans at the lowest level of planning.

Subsequently, regulatory guidelines on the formation of local typologies of landscape, known broadly as Landscape Character Assessment methodologies, can be prepared at the local level following godd practice guidelines (SNH 2012). In limited cases, Landscape Character Assessment tools have expanded to incorporate Seascape Character Assessment and Historic Character Assessment studies in an effort to comply with the principle of landscape as a whole; see, for example, the County Donegal Landscape Character Assessment in

Ireland, part of the HERICOAST project (Donegal City Council 2017).

To conclude, effective protection, planning and management of landscape depend on an integrated, multi-leveled, coherent and consistent in time landscape policy. When being acknowledged landscape in law and in the spatial planning framework through the revision of regional plans (RFSP&SD), it constitutes a significant step towards this direction. However, many challenges have yet to be addressed both at the conceptual and methodological level. These challenges become even more critical considering the deficiency of the Greek spatial planning to effectively tackle a number of socio-spatial problems having occurred in the country the last decades. Furthermore, the proposed horizontal implementation of a landscape policy in the spatial planning system constitutes for Greece a new approach, an approach that has been of limited experience even at the international level.

References

Antrop, M., 2005. Why landscapes of the past are important for the future. Landsc Urban Plan, 70(1–2), pp. 21–34. Available at: http://linkinghub.elsevier.com/retrieve/pii/S016920460300207X. Accessed 20 March 2017

Antrop, M., 2015. From holistic landscape synthesis to transdisciplinary landscape management. In P. Tress, B.; Tres, G.; fry, G.; Opdam, ed. *From Landscape Research to Landscape Planning: Aspects of Integration, Education and Application*. pp. 27–50

Batel, S. & Devine-Wright, P., 2015. Towards a better understanding of people's responses to renewable energy technologies: Insights from social representations theory. Public Underst Sci, 24(3), pp. 311–325. Available at: http://pus.sagepub.com/cgi/ https://doi.org/10.1177/0963662513514165. Accessed 20 Dec 2016

Bishop ID (2002) Determination of thresholds of visual impact: The case of wind turbines. Environ Plann B Plann Des 29(5):707–718

Bishop ID, Miller DR (2007) Visual assessment of off-shore wind turbines: The influence of distance, contrast, movement and social variables. Renew Energy 32(5):814–831

Bürgi M, Hersperger AM, Schneeberger N (2004) Driving forces of landscape change - current and new directions. Landsc Ecol 19(8):857–868

CGIAR-CSI, 2017. SRTM 90m digital elevation database v4.1 [online].URL http://srtm.csi.cgiar.org/. Accessed 12 Oct 2017

Chorianopoulos, I., Tsilimigkas G., Koukoulas S., Balatsos T., 2014. The shift to competitiveness and a new phase of sprawl in the Mediterranean city: Enterprises guiding growth in Messoghia - Athens. Cities, 39, pp. 133–143. Available at: http://www.sciencedirect.com/science/article/pii/S0264275114000407. Accessed 24 Oct 2017

Committee of Ministers, 2008. 'Recommendation CM/Rec (2008)3 of the Committee of Ministers to member states on the guidelines for the implementation of the European Landscape Convention', Strasbourg. Available at: https://rm.coe.int/16802f80c9. Accessed 2 Oct 2017

Council of Europe (2000) European Landscape Convention, Florence, 20.X.2000. ETS 176. Council of Europe, Strasbourg. Available at: URL http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm. Accessed 2 Oct 2017

Crumley C, Marquardt W (1990) Landscape : A unifying concept in regional analysis. In: Allen K, Green S, Zubrow E (eds) Interpreting space: GIS and archaeology. Taylor & Francis, London, pp 73–79

Daniel, T.C., 2001. Whither scenic beauty? Visual landscape quality assessment in the 21st century. Landsc Urban Plan, 54(1–4), pp. 267–281. Available at: http://www.sciencedirect.com/science/article/pii/S0169204601001414. Accessed 21 Nov 2016

Depellegrin D, Blažauskas N, Egarter-Vigl L (2014) An integrated visual impact assessment model for offshore windfarm development. Ocean Coast Manag 98:95–110

Devine-Wright P (2005) Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. Wind Energy 8(2):125–139

Dimitropoulos A, Kontoleon A (2009) Assessing the determinants of local acceptability of wind-farm investment: A choice experiment in the Greek Aegean Islands. Energy Policy 37(5):1842–1854

Donegal City Council, 2017. HERICOAST Project [online]. URL http://www.donegalcoco.ie/services/planning/hericoast%20project/. Accessed 20 Oct 2017

E.S.F. (European Science Foundation), 2010. Landscape in a Changing World, Science Policy Briefing 41, Strasbourg/Brussels. Available at: http://library.wur.nl/WebQuery/wurpubs/fulltext/161371. Accessed 23 Oct 2016

Economou D (2004) The urban policy in Greece. Structural characteristics and current tendencies. In: Economou D, Sarigiannis J, Serraos K (eds) *Poli kai horos apo ton 20o ston 21o aiona* [City and space from the 20th to the 21st century]. Memphis [in Greek], Athens, pp 371–382

ELSTAT (Hellenic Statistical Authority) (2011) Population census 2011. ELSTAT, Athens

EP&C. (European Parliament and the Council). 2007. Directive 2014/89/EU of the European Parliament and of the Council of 14 March 2007 Establishing an infrastructure for spatial information in the European Community (INSPIRE), Brussels: Official Journal of the European Union

Ervin S, Steinitz C (2003) Landscape visibility computation: Necessary, but not sufficient. Environ Plann B Plann Des 30:757–766. https://doi.org/10.1068/b2968

Falconer L, Hunter DC, Telfer TC, Ross LG (2013) Visual, seascape and landscape analysis to support coastal aquaculture site selection. Land Use Policy 34:1–10

Flannery, W., Ellis G., Ellis G., Flannery W., Nursey-Bray M., van Tatenhove J.P.M., Kelly C., Coffen-Smout S., Fairgrieve R., Knol M., Jentoft S., Bacon D., O'Hagan A.M., 2016. Exploring the winners and losers of marine environmental governance/marine spatial planning: Cui bono ?/"more than fishy business": epistemology, integration and conflict in marine spatial planning/marine spatial planning: power and scaping/surely. Plann Theory Pract, 17(1), pp. 121–151. Available at: https://doi.org/10.1080/14649357.2015.1131482. Accessed 18 Dec 2016

Freire, S., Halkia, M. & Pesaresi, M., 2016. GHS population grid, derived from Eurostat census data (2011) and ESM 2016, Joint Research Centre. Available at: http://data.europa.eu/euodp/en/data/dataset/57cfffbd-3776-49c6-ab8e-f56cad09420f. Accessed 13 Oct 2017

Garcia-Martin, M., Fagerholm N., Bieling C., Gounaridis D., Kizos T., Printsmann A., Müller M., Lieskovský J., Plieninger T., 2017. Participatory mapping of landscape values in a pan-European perspective. Landsc Ecol, 32 (11), pp. 1–18. Available at: https://doi.org/10.1007/s10980-017-0531-x. Accessed 17 Oct 2017

Gourgiotis, A. & Tsilimigkas, G., 2016. Transition énergétique et planification spatiale: l'expérience Hellénique. Géographies, Géopolitiques et Géostratégies Régionales, IV(1), pp. 43–54. Available at: https://ideas.repec.org/a/hrs/jrnggg/vivy2016i1p43-53.html. Accessed 18 Oct 2017

Hill, M. et al., 2001. Guide to best practice in seascape assessment countryside Council for Wales Measure 1.3: protection of the marine and coastal environment and marine emergency Planning, Available at: http://oar.marine.ie/bitstream/10793/553/1/INTERREG%205%20Guide%20to%20Best%20Practice%20in%20Seascape%20Assessment.pdf. Accessed 18 Oct 2017

ICOMOS (International Council on Monuments and Sites) (2008) Declaration on the preservation of the Spirit of place. Canada, Quebec

Jones, N., Koukoulas S., Clark J.R.A., Evangelinos K.I., Dimitrakopoulos P.G., Eftihidou M.O., Koliou A., Mpalaska M., Papanikolaou S., Stathi G., Tsaliki P., 2014. Social capital and citizen perceptions of coastal management for tackling climate change impacts in Greece. Reg Environ Chang, 14(3), pp. 1083–1093. Available at: https://doi.org/10.1007/s10113-013-0540-5. Accessed 18 Oct 2017

Jude, S. et al., 2015. Visualising potential coastal change: communicating results using visualisation techniques. In R. J. Nicholls, R. J. Dawson, & S. A. Day, eds. Broad Scale Coastal Simulation*: New Techniques to Understand and manage Shorelines in the Third Millennium*. Springer, pp. 255–272

Karampela, S., Kizos, T. & Spilanis, I., 2014. Accessibility of islands: Towards a new geography based on transportation modes and choices. Island Studies Journal, 9(2), pp. 293–306. Available at: https://www.researchgate.net/publication/267510407_Accessibility_of_islands_Towards_a_new_geography_based_on_transportation_modes_and_choices. Accessed 18 Oct 2017

Karidis, D., 1996. *Anagnosi poleodomias: i koinoniki simasia chorikon morfon* [urban planning study: The social significance of spatial forms]. Symmetria, Athens pp 336–337 [in Greek]

Kiousopoulos, J., 2008. Methodological approach of coastal areas concerning typology and spatial indicators, in the context of integrated management and environmental assessment. J Coast Conserv, 12(1), pp. 19–25. Available at: https://doi.org/10.1007/s11852-008-0019-6. Accessed 18 Oct 2017

Kizos, T., 2008. Rural environmental management in Greece as a cultural frontier between the "occident" and the "orient." *ARBOR Ciencia, Pensamiento y Cultura*, CLXXXIV(729), pp. 127–142

Kizos, T., 2014. Social-cultural values of oak wood-pastures and transhumance in Greece. In T. Hartel & T. Plieninger, eds. *European wood-pastures in transition: a social-ecological approach*. Routledge, pp. 171–184

Kizos T, Vlachos G (2012) The evolution of the agricultural landscape. Reclaiming the Greek landscape 97(2):133–143

Kaldellis, J.K. & Kavadias, K.A., 2004. Evaluation of Greek wind parks visual impact. "The public attitude." Fresenius Environ Bull, 13(5), pp. 413–423. Available at: https://www.researchgate.net/publication/266473689_Evaluation_of_Greek_wind_parks_visual_impact_The_public_attitude. Accessed 18 Oct 2017

Landscape Observatory, 2014. Landscape Observatory of Catalonia [online]. URL http://www.catpaisatge.net/eng/index.php. Accessed October 2017

Lefebvre, H., 1991. *The Production of Space* English tr. D. Nicholson-Smith, ed., The Production of space. Oxford: Blackwell

MD (Ministerial Decision), 2017. "Procedure for issuing permissions for the installation and operation of power stations with the use of renewable energy resources", no. 13310, "Diadikasia ekdosis adeion egkatastasis Kai leitourgias stathmon paragogis ilektrikis energeias me chrisi ananeosimon pigon energeias", Athens

MEECC (Ministry of Environment, Energy and Climate Change), (2010). Prodiagrafes meleton aksiologisis, anatheorisis and eksidikefsis thesmothetimenon periferiakon plaision xorikou sxediasmou Kai aiforou anaptiskis. Ypourgeio Perivallontos Energeias Kai klimatikis allagis. (specification studies - assessment, Review and specialization of the institutionalized regional frameworks for spatial planning and sustainable development)

MEECC (Ministry of Environment, Energy and Climate Change), (2015). Axiologisi, Anatheorisi Kai Exeidikefsi Tou Perifereiakou Plaisiou Chorotaxikou Schediasmou Kai Aeiforou Anaptyxis Perifereias Notiou Aigaiou. Ypourgeio Perivallontos Energeias Kai klimatikis allagis. (Review and specification study of the institutionalized regional framework for spatial planning and sustainable development of south Aegean region)

Meinig, D.W., 1979. *The interpretation of ordinary landscapes Geographical Essays* D. W. Meinig, ed., New York: Oxford University Press

MEPPPW (Ministry for the Environment, Physical Planning and Public Works), 2003. Egkrisi eidikou plaisiou chorotaxikou sxediasmou kai aeiforou anaptyxis gia ton paraktio xoro kai ta nisia kai tis stratigikis meletis periballontikon epiptoseon autou [Draft law on "Special framework on spatial planning and sustainable development of the coastal zones and the islands and strategy study of environmental impact of this

Möller B (2006) Changing wind-power landscapes: regional assessment of visual impact on land use and population in northern Jutland, Denmark. Appl Energy 83(5):477–494

Möller B (2010) Spatial analyses of emerging and fading wind energy landscapes in Denmark. Land Use Policy 27(2):233–241

Moore, S.A. et al., 2017. Identifying conflict potential in a coastal and marine environment using participatory mapping. J Environ Manag, 197, pp. 706–718. Available at: doi:https://doi.org/10.1016/j.jenvman.2016.12.026. Accessed 10 Oct 2017

Mouflis, E. et al., 2008. Assessment of the visual impact of marble quarry expansion (1984–2000) on the landscape of Thasos island, NE Greece. Landsc Urban Plan, 86(1), pp. 92–102. Available at: http://www.sciencedirect.com/science/article/pii/S0169204608000054#bib34. Accessed 10 Oct 2017

NE (Natural England), 2012. An Approach to Seascape Character Assessment. Commissioned Report NECR105. Available at: http://publications.naturalengland.org.uk/publication/2729852. Accessed 5 Oct 2016

Nutsford, D. et al., 2015. Personalising the viewshed: Visibility analysis from the human perspective. Appl Geogr, 62, pp.1-7. Available at: doi:https://doi.org/10.1016/j.apgeog.2015.04.004. Accessed 10 Oct 2017

OGG. 1950. "On the protection of buildings and works of art in subsequent of 1830", Greek official journal 169/a'/07.08.1950. "Prostasia ikodomimaton, ergon texnis metagenesteron tou 1830″, Efimeris tis Kyverniseos 169/A'/0708.1950

OGG. 1997. "On sustainable residential development of towns and settlements in the country and other provisions", Greek official journal A -124/13–6-1997. "Viosimi oikistiki anaptyxi ton poleon Kai oikismon tis choras Kai alles diataxeis", Efimeris tis Kyverniseos A'-124/13–6-1997

OGG. 1999. "Spatial planning and sustainable development and other provisions", Greek official journal 207-A/07.10.1999. "Chorotaxikos schediasmos Kai aeiforos anaptyxi Kai alles diataxeis", Efimeris tis Kyverniseos 207-A/0710.1999

OGG. 2008a. General Spatial Planning and Sustainable Development Framework. Greek Official Journal 128-A/03.07.2008. "Geniko Plaisio Chorotaxikou Schediasmou Kai Aeiforou Anaptyxis", Efimeris tis Kyverniseos 128-A/0307.2008

OGG. 2008b. Special Framework for Spatial Planning and Sustainable Development for Renewable Energy Resources and the Strategic Environmental Impact assessment. Greek Official Journal 2464 B/03.12.2008. "Eidiko Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis gia tis Ananeosimes Piges Energeias kai tis Stratigikis Meletis Perivallontikon Epiptoseon aftou". Efimeris tis Kyverniseos 2464 B/0312.2008

OGG. 2009a. Special framework for spatial planning and sustainable development for industry and the strategic environmental impact assessment. Greek official Journal 151 AAΠ/ 13042009 "Eidiko

Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis gia ti Viomichania kai tis Stratigikis Meletis Perivallontikon Epiptoseon aftou Efimeris tis Kyverniseos 151 AAΠ/1304.2009

OGG. 2009b. Special Framework for Spatial Planning and Sustainable Development for Tourism and the Strategic Environmental Impact Assessment. Greek Official Journal 1138 B/ 11.06.2009). "Eidiko Plaisio Chorotaxikou Schediasmou Kai Aeiforou Anaptyxis gia ton Tourismo Kai tis Stratigikis Meletis Perivallontikon Epiptoseon aftou". Efimeris tis Kyverniseos 1138 B/ 11.06.2009

OGG. 2011. Special Framework for Spatial Planning and Sustainable Development for Aquaculture and the Strategic Environmental Impact Assessment. Greek Official Journal 2505/B/ 04.11.2011. "Eidiko Plaisio Chorotaxikou Schediasmou kai Aeiforou Anaptyxis gia tis Ydatokalliergeies kai tis Stratigikis Meletis Perivallontikon Epiptoseon aftou". Efimeris tis Kyverniseos 2505/B/0411.2011

OGG. 2014. "Regional and urban planning reformation - sustainable development", Greek official journal 142/A/28-6-2014. "Chorotaxiki Kai poleodomiki metarrythmisi - Viosimi Anaptyxi", Efimeris tis Kyverniseos 142/A/28–6-2014

OGG. 2016. "Spatial planning-sustainable development and other provisions", Greek official journal 241/A/23-12-2016. "Chorikos schediasmos - Viosimi anaptyxi Kai alles diataxeis", Efimeris tis Kyverniseos 241/A/23–12-2016

O'Sullivan D, Turner A (2001) Visibility graphs and landscape visibility analysis. Int J Geogr Inf Sci 15(3):221–237

Plieninger T et al (2015) Exploring ecosystem-change and society through a landscape lens: recent progress in European landscape research. Ecol Soc 20(2):5

RAE (Regulatory Authority for Energy), 2017. Wind turbines point vector shapefile [online]. URL http://www.rae.gr/geo/. Accessed 12 Oct 2017

Serraos, K., Gianniris, E. & Zifou, M., 2005. The Greek spatial and urban planning system in the European context. In G. Padovano & C. Blasi, eds. *Complessitá e Sostenibilitá, Prospettive per i territori europei: strategie di pianificazione in dieci Paesi, Rivista bimestrale di pianificazione e progrettazione*. Poli Design Publishing, pp. 1–24

Shang H, Bishop ID (2000) Visual thresholds for detection, recognition and visual impact in landscape settings. J Environ Psychol 20(2): 125–140

SNH (Scottish Natural Heritage), 2012. Offshore renewables-guidance on assessing the impact on coastal landscape and seascape: guidance for scoping an Environmental Statement, Available at: https://tethys.pnnl.gov/sites/default/files/publications/SNH_2012_Guidance.pdf. Accessed 15 Dec 2016

SNH (Scottish Natural Heritage), 2014. Visual representation of wind farms, Version 2.1. Available at: https://www.snh.scot/docs/A2203860.pdf. Accessed 15 Dec 2016

SNH (Scottish Natural Heritage), 2017. Visual Representation of Wind farms, Version 2.2. Available at: https://www.snh.scot/sites/default/files/2017-07/A2203860%20-%20Visual%20representation%20of%20wind%20farms%20-%20Guidance%20-%20Feb%202017.pdf. Accessed 13 Nov 2017

Soini, K., 2001. Exploring human dimensions of multifunctional landscapes through mapping and map-making. Landsc Urban Plan, 57(3), pp. 225–239. Available at: http://www.sciencedirect.com/science/article/pii/S0169204601002067. Accessed 5 June 2017

Stephenson J (2008) The cultural values model: an integrated approach to values in landscapes. Landsc Urban Plan 84(2):127–139

Stewart, W.P., Liebert, D. & Larkin, K.W., 2004. Community identities as visions for landscape change., 69, pp. 315–334

Terkenli TS (2001) Towards a theory of the landscape: the Aegean landscape as a cultural image. Landsc Urban Plan 57(3–4):197–208 Available at: http://www.sciencedirect.com/science/article/pii/S0169204601002043

Terkenli TS (2005) New landscape spatialities: the changing scales of function and symbolism. Landsc Urban Plan 70(1–2):165–176 Available at: http://www.sciencedirect.com/science/article/pii/S0169204603002184

Thompson R (2007) Cultural models and shoreline social conflict. Coast Manag 35(2–3):211–237

Tress B, Tress G (2001) Capitalising on multiplicity: a transdisciplinary systems approach to landscape research. Landsc Urban Plan 57(3–4):143–157

Tsilimigkas G, Derdemezi E-T (2017) "What do you see in the landscape?": visibility analysis in the island landscape of Sifnos. Island Studies Journal 12(1):35–52

Tsilimigkas G, Kizos T (2014) Space, pressures and the management of the Greek landscape. Geografiska Annaler, Series B: Human Geography 96(2):159–175

Tsilimigkas G, Stathakis D, Pafi M (2015) Evaluating the land use patterns of medium-sized Hellenic cities. Urban Research and Practice 9(2):181–203

Tsilimigkas G, Deligianni M, Zerbopoulos T (2016) Spatial typologies of Greek coastal zones and unregulated Urban growth. J Coastal Conserv 20(5):397–408. https://doi.org/10.1007/s11852-016-0453-9

Tsoutsos, T. et al., 2006. Aesthetic impact from wind parks. In European wind energy conference and exhibition 2006, EWEC 2006

Tsoutsos T et al (2009) Visual impact evaluation of a wind park in a Greek island. Applied Energy 86(4):546–553. https://doi.org/10.1016/j.apenergy.2008.08.013

Tuan Y-F (1979) Thought and landscape: the eye and the mind's eye. In: Meinig DW (ed) The interpretation of ordinary landscapes geographical essays. Oxford University Press, New York, pp 89–102

Wheatley D, Gillings M (1999) Vision, perception and GIS : some notes on the development of enriched approaches to the study of archaeological visibility issues in GIS-based visibility-Viewshed analyses what is visibility ? In: Lock G (ed) Beyond the map: archaeology and spatial technologies. IOS Press, Amsterdam