

SUSTAINABLE RESEARCH AND DEVELOPMENT OF THE SMALL UNINHABITED ISLANDS: THE CASE OF IONIAN OINOUSSES

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ABSTRACT

It is acceptable that the uninhabited islands of small size, due to their isolation from the mainland, offer remarkable habitats for the distribution and conservation of significant protected flora and fauna species. Many of these islands hosted in the past settlements, castles, etc., that now have been abandoned, though the characteristics of the landscape and the types of economy have not been altered to present. Albeit they do not sustain human habitation, the deterioration of their environment is owing to human intervention. The Oinousses island complex (consisting of three major islands: Sapienza, Schiza and Agia Mariani) retain a well-preserved and undisturbed natural environment as well as a rich wild life biodiversity. The main aim of the current research is to provide an effective tool which will serve the sustainable counterbalance development in remote insular areas around Greece. This will be achieved by using an environmental assessment methodology (Leopold Matrix) that will contribute to the evaluation of the emergent environmental impacts. The monitoring and management of these islands in the future will be based on the conservation of their insular features (as a basic principle of sustainability) and the soft actions that must be adopted with respect to their natural environment.

KEYWORDS: isolated islands, natural environment, conservation and protection, Leopold Matrix.

1. INTRODUCTION

The small uninhabited islands of Greece either from a spatial, economic or environmental perspective are regarded as special case studies for immediate protection due to their specific characteristics and various features (Alexopoulos, 2002). These islands concern restricted land-areas that have been detached from the mainland or other (bigger) islands in the past. The dominating environmental and ecological conditions (type of coastline, fauna, flora, etc) of each island have created unique ecosystems that even differentiated them from the neighbouring islands (Alexopoulos, 2003).

In consequence, geomorphology and biogeography are determinant factors for the types of ecotopes that can be found in these land-areas as well as the scale of their isolation. It is evident that the most isolated islands are the less exposed to human uses which could lead to disturbance and are frequently considered as suitable and vital refuges for the most rare fauna and flora species. According to the Hydrographic Survey (Greek Navy), the Oinousses islands of the Ionian Sea (frequently called as the islands of Messinian Prefecture) consist of 25 islands and islets. In this study, three of the Oinousses islands named as Sapienza, Ag. Marina and Schiza will be investigated. The group of the above islands are uninhabited and directly located opposite to Methoni coastline. In other words, although this island complex is not far from the mainland, it is not

a typical example of tourist destination (Alexopoulos, 2008). In fact, environmental priorities for the protection of the natural and the marine environment have only been detected for Sapienza Island. The main aim of this study is the conservation and the promotion of the natural environment of these three islands that constitute a remarkable part of the Greek natural heritage and they must be established as areas of protection and development with the explicit involvement of actions taken by the responsible national administrative authorities.

2. LITERATURE REVIEW

In general, there is a limited number of adequate information and scientific publications about small size islands (either inhabited or not) whereas the majority of them are confined to the scientific research related to their natural flora and fauna as well as their geological characteristics (Fauna Europaea, 2004; Papaconstantinou, 2007; Legakis and Kypriotakis, 1994; Sfenthourakis and Legakis, 2001; Dimalexis *et al.*, 2008; Karris *et al.*, 2009). Most references usually refer to ocean-islands because the importance of their natural marine and terrestrial environment has been recognised. Moreover, these islands are natural resorts for the majority of the marine species (usually endemic and rare) either for reproduction or protection purposes as well as by constituting important stopovers for the migratory flow of avifauna species (Alexopoulos, 1997).

More specifically, the Oinousses group of islands (Figure 1) enjoys very few reports and even less studies with the majority of them to concern their historical background which is strongly connected with the cultural history of Methoni (the nearby coastal ancient town). The lack of relevant literature could be explained also by the fact that Oinousses are not considered as a well known tourist destination. The seas surrounding these islands and the strait of Methoni are characterized by very deep waters (the deepest point of the Mediterranean Sea which reaches a depth of 5,012 m is located on a marine area southwest of Methoni, known as the Well of Oinousses)¹.

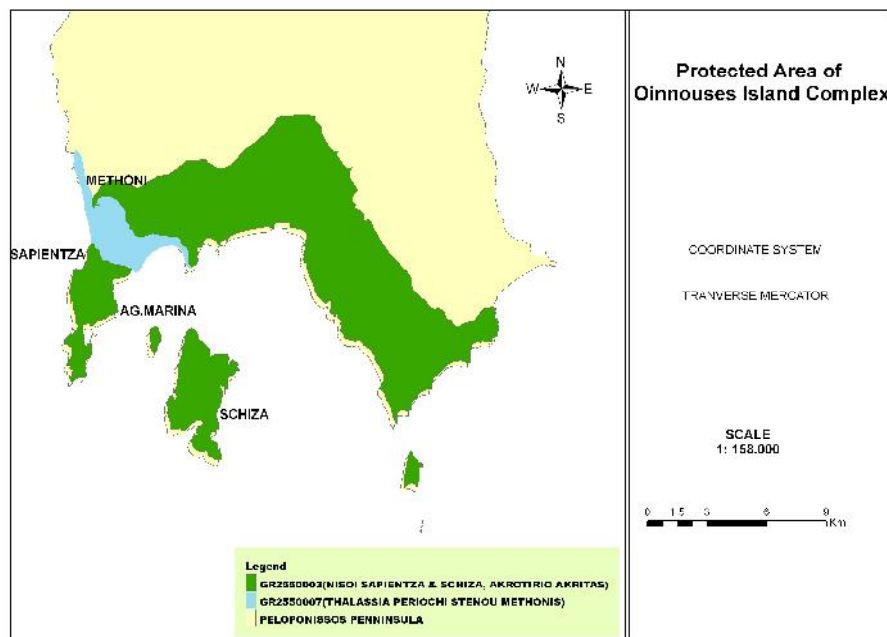


Figure 1. Map of Ionian Oinousses Island Complex

Furthermore, the wider marine area is known for the great number of shipwrecks. A large number of Venetian and later of Turkish fleets had been lost. In addition, these islands played an important role on piracy actions in the past, since: (a) they were frequent points of attacks against passing-by ships, (b) their geographical location allowed the monitoring and control of the whole area and (c) they were suitable places for shelters (Iordanoglou, undated).

Nowadays, the wider sea area encompassing the coasts of Methoni, Foinikounta up to the south of Koroni (Akritas cape), the four islands of Sapienza, Schiza, Agia Marina and Venetiko as well as the strait between the coastline of Methoni and Sapienza Island is divided into two protected areas. These areas are defined as Sites of Community Interest (SCIs) due to the Natura 2000 Network with

respective site codes GR255003 (Nisoi Sapientza and Schiza, Akrotirio Akritas) and GR255007 (Thalassia periochi Stenou Methonis)².

According to the Natura 2000 Network (EEA, 2010), the protected habitat types of the first site (GR255003) include embryonic shifting dunes, tree spurge formations, Aegean phrygana, sclerophyllous grazes forests, EU-Mediterranean Greek calcareous cliffs and oriental plane woods. However, particular interest is placed on the endemic *Limonium* taxa that are hosted on the rocky beaches and the sea cliffs of the coastal area as well as the co-existence of 29 important vertebrate taxa excluded birds. The highest importance of the second site (GR255007) lies most at the marine vegetation of the area. The protection of the endemic species *Posidonia oceanica* which population is extended at this area in high densities is the first priority of the Natura Network since this phanerogam is also used as a bioindicator of the ecological condition of the area. At the same time, the seagrass *Halophila stipulacea* has invaded the Mediterranean seabed of *Posidonia oceanica* and the alga meadows of *Caulerpa prolifera* from the Indian Ocean through the Suez Canal; the westernmost post of this species is at the protected area of Methoni. Another important species of the marine fauna is the fish *Signathus abaster*. It is imperative to mention that the coasts of the specific protected area host a considerable number of marine turtles *Caretta caretta* that lay on these beaches.

2.1 The Island of Schiza (previously named Kabrera)

Schiza Island constitutes an insular area of 12 km² (being the largest island of Oinousses) with low hills since the maximum altitude reaches up to 200 m and has no recreational beaches. The coastline is characterized by rocky shores and deep waters while in the south part there is a sheltered bay frequently used by fishing vessels. In the northeast part of the island, close to the coast there is a cave formed with stalactites. The natural flora is mainly consisted of shrubs whereas the natural fauna is represented by small mammals such as rodents, reptiles and amphibians.

The most significant issue regarding Schiza Island is the fact that it has been characterized as a restricted area due to the military activities that took place for a long period of time (preannouncement of the aircraft butts). The Hellenic Air Force has deployed permanent targets in the eastern coasts of the island. In the past two significant accidents had been documented. In 1997 two aircrafts (A-7 Corsair) had come in contact during a routine flight exercise and sunk in the sea but the pilots were saved whereas one year later, a similar accident occurred, causing the pilot's death (Giagakis, 2000).

However, it is arguable when and under which circumstances the aircraft butts of Schiza Island was activated. By the end of 1970 the sea area was used for military services. Although all the military operations were ceased³ after two decades (1990), the Oinousses reuse for military exercises is again vigorously debated. In the past, the local community was strongly opposed towards those operations because it was an impaired factor for tourism development and caused severe marine pollution from ballistic missiles⁴, i.e. high concentrations of pollutants (toxic heavy metals: lead, cadmium, mercury) have been detected in commercial fisheries according to the respective Community legislation⁵. In 2010 the butts was re-activated but limited to the training of young officers flying the T-2 type of aircraft with specific ammunition.

Table 1. Pollutant (Heavy Metal) levels of the marine ecosystem around the Schiza Island as a result of military exercises

	Lead (Pb)	Cadmium (Cd)	Mercury (Hg)
Acceptable EU* Limits (mg)	0.2	0.05	1.0
Sample A	13.6-68 (over)	0.1-2 (over)	0.12
Sample B	1.1-5.5 (over)	0.7-1.4 (over)	0.13
Sample C	0.104 (over)	0.383-7.66 (over)	1.77(over)

*European Union

Table 1 shows the results of a chemical analysis project (samples were sent to the National General Chemical Laboratories of Greece and Italy during 2001-2002). Nevertheless, the results were thought as non valid since the analysis procedure did not meet the necessary specifications.

2.2 Agia Marina (previously named Agia Mariani)

Agia Marina is the smallest island of the Oinousses and it is located between the two larger islands Schiza and Sapientza, in a small distance from the coastline of Methoni. In fact, it is regarded as a flat island (altitude less than 30m), covering an area of 512 acres with a total coastline length of 3,117 m. The characteristic natural flora of the island is a mosaic of low and dense bushes (phrygana and maquis vegetation) while at higher altitudes there are few olive and pine trees. A small church dedicated to Saint Marina has been recently built (where an old temple used to be) and constitutes the only religious place in the Oinousses group of islands with regular visits. The coastline is mainly rocky with the exception of a vestigial jetty for anchoring and one small sandy beach.

2.3 Sapientza (previously named Sakiotsa)

As well as the pre-mentioned islets, Sapientza belongs to the Municipality of Methoni and it is considered as state property which is under the management of Kalamata Forestry Services⁶. This flat island with an altitude of 219 m has a total surface area of approximately 9 km². The island is characterized by rocky coastline and only one sandy beach (named: Ammos) suitable for swimming, located on the north part of the island. In the east side there is a small jetty (named: Magazakia) for small crafts to dock and constitutes the starting point for discovering the island by using marking trails.

The mountains on the island form a protected valley that hosts the unique forest of *Arbutus sp.* (trees with height of 10-12 m) which is native to warm temperate Mediterranean regions. The forest is growing naturally owing to geographic isolation, prevailing weather conditions and absence of fires over the last 60 years (Basyiourakis, 2003). The whole area has been declared as a "Listed Natural Monument" in 1986.

In comparison with the other regions of the protected area, Sapientza is forested and the natural flora of this island is quite dense (hollys, oleasters, myrtles, aspalathoi, furzes, oaks, wild flowers) which obstructs the visibility between paths and make them inaccessible. In addition, the area hosts a great number of wild goats and wild sheep (mouflon)⁷ as well as a great biodiversity of avifauna species such as pheasants, partridges, quails, snips etc. However, hunting is charged and controlled by forestry wardens and according to respective legislation, short time periods for hunting, the maximum number of hunters, the type of weapons and the quantity of hunting game animals are specified.

Table 2. Spatial features of Oinousses island complex

Island	Length of coastline (km)	Area (km ²)
Sapientza	21.89	9.018
Schiza	19.79	12.13
Ag. Marina	3.11	0.518
Dio Adelfia (a)	0.76	0.0370
Dio Adelfia (b)	0.45	0.0110
Arnatsi	0.19	0.0014
Kaliora	0.38	0.0060
Kolios	0.26	0.0050
Kouloura	0.28	0.0050
Marathos	0.20	0.0020
Boba	0.88	0.0390
Paporia (a)	0.17	0.0013
Paporia (b)	0.20	0.0014
Unnamed (15)	0.12 – 0.26	0.0010 – 0.0029

In the south-eastern area of the island, there is a natural semi-closed bay (named: Porto Loggo) which is a secure place for berthing. "Boba" islet is located at the entrance of this bay where a great number of shipwrecks have been found. The presence of aquaculture activities near the port has caused some pollution. Trails start from this location and lead to the lighthouse⁸ of Sapientza.

According to the official data produced by the Hydrographic Survey, the total area of the Oinousses island complex is presented in Table 2.

3. METHODOLOGY

The methodological approach for the evaluation of the raw data-features will be based on the context of the Environmental Impact Assessment (EIA) by using an important and effective method named “Leopold Matrix”-LM (Leopold *et al.*, 1971). This environmental management tool will allow for the inventory of the several uses that take place in the three islands, the assessment of their impacts on their wider environment (Alexopoulos, 2001a) and finally, the reflection of an effective management plan that will secure the sustainable future for these small islands⁹.

The LM is one of the most important and common methodologies for the prediction of the environmental impacts caused by several human activities. It puts forward a system that analyses and assesses the potential environmental impacts. This analysis does not give an integrated quantitative result rather than it provides adequate and remarkable qualitative outcomes. The main goal of this methodology is to ensure that the impacts of the alternative scenarios on the environment have been thoroughly assessed and evaluated.

The process of LM requires the definition of two parameters for each action that can cause negative effects on the environment. The first parameter is the magnitude of each effect on a particular sector or sectors of the environment. In our case, the term magnitude illustrates the degree, the extensiveness or the scale of the impact. The second parameter is the importance, i.e. the significance of the proposed measures for some particular environmental attributes or conditions. Evidently, the assessment of the first parameter (magnitude) is an easy task and is based on available data while the second parameter (importance) is mainly dependent upon the personal judgment of the researcher. The main components of the LM are presented in the following figure:

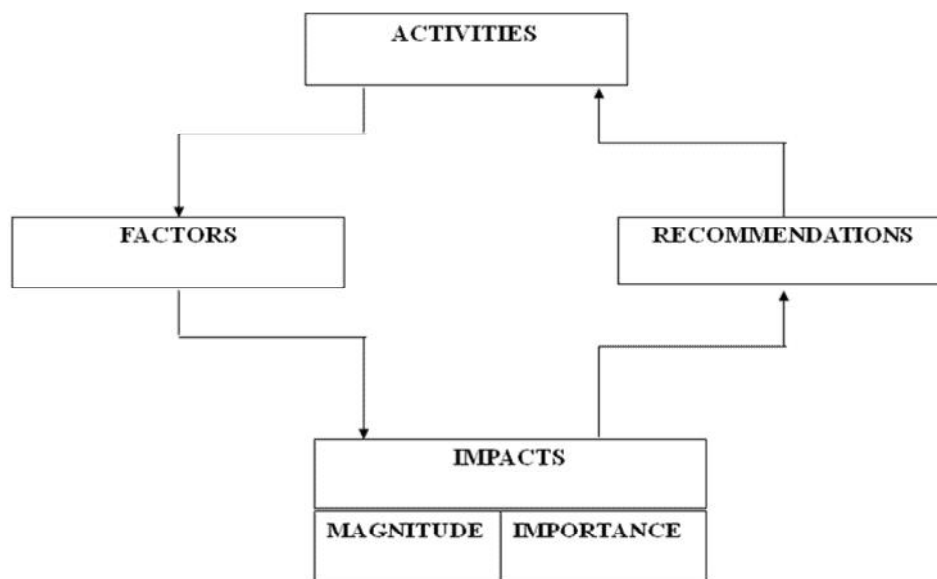


Figure 2. Main steps of the Leopold Matrix method

The first step of the LM is to design a matrix which consists of 100 specialized activities that affect the environment (horizontal axis) and 88 existing environmental elements that can possibly be harmed by the above activities (vertical axis). Essentially, this matrix provides 8.800 interactions but in practice only a particular number of those can cause significant impacts in terms of magnitude and importance so that they can be dealt accordingly. This provides the format for an extensive review of the interactions between the proposed (human) interventions and the environmental factors (features and conditions).

The parameter “magnitude” is described with the determination of a value scaled from 1 (low magnitude) to 10 (high magnitude) and is based on the evaluation of the provided data. The parameter “importance” is measured in a similar way and is based on the subjective judgment of the researcher. The LM approach is quiet flexible regarding the evaluation of a number of particular

activities which take place in a region and the respective environmental data where the score of the pre-mentioned parameters may increase or decrease depending on the nature and the aim of the research as well as the specific causes that contribute to the environmental impacts (Ponce, 2010).

4. DISCUSSION

For the current study a table was created, based on the LM that has been designed for the purposes of our research. The matrix includes the human interventions/activities and the environmental conditions/impacts for each case. Usually the number of interactions for a typical study varies between 25 and 50.

A close look at this existing situation of the Oinousses islands contributed to a thoughtfully development of a representative matrix (Table 3) that mirrors the natural and human environment dominated in this area.

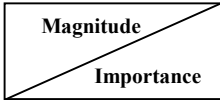
The most effective method for the critical evaluation of the matrix is the analysis of every significant activity on the horizontal axis. Usually, almost 12 activities have a vital role and it is imperative to examine their impacts on the environment on short-term and long-term basis. The high or low value in every cell indicates the degree of impact that can be generated by a human activity on a specific environmental factor. The pre-analyzing stage of matrix components must take into consideration some additional factors:

- According to the Common Ministerial Decision of 2007 “Spatial Framework for Tourism” the “rock islands” and the uninhabited islands are classified into two categories based on their natural characteristics, their size and their proximity to inhabited areas. Rock islands enjoy total protection¹⁰ while in uninhabited islands the development of tourism establishments is allowed, provided that the latter will not cover more than 2% of the total area of the islands, depending also on other existing regulations.
- For the protected areas under the Network of Natura 2000 sites, new forms such as soft tourism are proposed for the sustainable development of resources, i.e. agritourism, sightseeing, hiking, cultural tourism, etc (Alexopoulos and Theotokas, 2000).
- Albeit knowing the winds’ intensity, the investments in renewable sources of energy have to be planned carefully, taking into consideration all the particular attributes that characterize every single area. Due to their unique geomorphology and features of the marine offshore areas and the uninhabited islets, they are regarded as special occasions and for that reason they are customized by different criteria in their spatial planning, i.e. in relation to navigation, to the way of constructing etc (Alexopoulos and Politis, 2000; Alexopoulos, 2001b).

Hence, we observe that the environmental management and protection are essential policies in the wider context of “quality of land”, “fauna”, “flora”, “ecosystem” and “coastal zone” as well as the dangers threatening them, i.e. accidents, marine pollution, military activities, shipwrecks (threats with high degree of importance). Human activities like hunting and aquaculture are also significant and extensive factors but they are not of high importance. This is due to the fact that games retain an ecological balance (since very short periods of hunting are allowed where only the old males of game animals are killed) in relation to the management of wild life. In addition, aquaculture facilities offer employment for the neighbor communities even if they may affect the quality of the local marine ecosystem.

The last two activities that are worth mentioned from the “importance” perspective, either on a short or long term basis, are the “tourism installations” and the “waste management plans”. Tourism may provide economic growth to these islands but at the same time could pose threats to coastal zone, habitats, water resources and air quality. Furthermore, waste management plans are still at an infant stage and the construction of new establishments (i.e. tourism, energy) may lead to a worse situation.

Table 3. Leopold Matrix for the Oinnoises island complex

Assessment Method 				ACTIVITY										
				Tourism Establishments	Fishery (illegal, aquacultures)	Hunting	Energy	Ports	Management of wild fauna	Shipping, Boating activity	Waste Mangement, Pollution	Military activities shipwrecks, accidents, pollution	TOTAL	
ENVIRONMENTAL CONDITIONS	PHYSICAL FACTORS	soil	soil quality	2/6		6/8	1/6	3/2	7/9		1/9	9/10	29/50	
			erosion	2/5				2/5			2/9	8/10	14/29	
			geomorphology	2/5					7/9		2/9	8/10	19/29	
		water	water quality	2/8	6/2			3/2		8/4		8/10	27/26	
			coastal zone	3/10	8/10			3/8		8/9	2/8	8/7	32/52	
			groundwater						6/6		2/7		8/13	
		air	air quality			7/2	1/6					8/6	16/14	
			noise	3/5		7/6						8/8	18/19	
			fumes								2/9		2/9	
	BIOLOGICAL FACTORS	flora	forests			6/10			6/10				12/20	
			harvests			6/1			6/2				12/3	
			habitats			6/6			6/9		2/9		14/24	
		fauna	mammals			7/10			7/10				14/20	
			birds			7/10			7/10				14/20	
			fishes		9/10					8/5		9/10	26/25	
		ecosystem	quality	3/6		6/9			7/10		2/9	8/10	26/44	
	disasters			5/10	6/8						8/10	19/28		
	SOCIAL FACTORS	land use	tourism	3/9				2/6	7/10	7/9			19/34	
			industry		6/4		1/5				2/8		9/17	
			transportation	3/5				2/4		6/5			11/14	
		culture	landscape	3/8			1/7	2/7	7/8		2/6	8/10	23/46	
			history									8/10	8/10	
			heritage									7/9	7/9	
		social	population	2/4					1/3					3/7
			employment	3/6	6/5				2/4		2/6			13/21
	dangers			7/10	7/9				6/9	3/8	9/10		32/46	
	TOTAL				31/77	47/51	73/79	4/24	18/41	73/93	43/39	25/97	114/130	

5. CONCLUSIONS

The Oinousses island complex, as a field of study, host a unique natural environment with a *number of protected species, and this is the reason that they constitute a Natura 2000 site*. This fact cannot get along with the activation of butts in the area. The prohibition of such activities eliminates the possibility of further pollution in the area not only for short periods but also in the long run where it is much more difficult to assess.

The alternative forms of tourism such as ecotourism (Alexopoulos *et al.*, 2009; Alexopoulos, 2005) may contribute to the sustainable development of the Oinousses group of islands. More specifically, the development of diving tourism has numerous benefits. Firstly, the creation of thematic submarine parks will provide a framework of environmental conservation, due to the many shipwrecks in the strait of Methoni along with the need for developing the science of “marine archeology” in Greece.

Likewise, the development of cultural tourism will be enhanced through the promotion of natural and cultural components of the area, i.e. cultural heritage (Alexopoulos and Katarellos, 2003). Furthermore, the development of sightseeing and hiking tourism with the creation of a network of environmental trails and routes will attract possible visitors. The case of marine tourism is essential, provided that the port of Kalamata will be the focal point equipped with modern infrastructure (mooring, maintenance, refueling) and offering services to the coastline and islands of the south Peloponnese peninsula.

Finally, the task of waste treatment and disposal could be solved by establishing a Station of Wastes for Temporary Treatment (SWTT), closed type and of high pressure, as a part of an integrated system of managing garbage and other wastes for the prefecture of Messinia.

Notes

¹ Usually the significance of deep waters surrounding islands is considerably high, since they are regarded as “marine oases” for the oligotrophic ecosystems of Mediterranean Sea.

² According to the 92/43/EU Habitats Directive, the Sites of Community Importance are being defined, taking into consideration all the types of ecosystems and the relevant criteria. The SCI list concerning the ecosystems of Mediterranean has been announced in the E.U. L259 vol.49 21/09/2006. State-members are obliged within a 6-year period to declare these areas as Special Areas of Conservation and define the priorities for the management and satisfying condition of those habitats and species.

³ Officially, the operation of the butts ended in 2006 due to the strong opposition expressed from the local community.

⁴ In the past, a study has been conducted by the Prefecture of Messinia showing high concentrations of lead in the samples of sea water that were probably attributed to the military exercises that took place. In parallel, active members of the local community in collaboration with the Organization of the Biological Products Accreditation had taken similar actions and delivered sea water samples to the Italian Laboratories for analysis.

⁵ This resembles a similar case in the Bay of Minamata (Japan) where the consumption of large amounts of polluted fish caused severe diseases and deaths to a great number of Japanese fishermen. The main cause of these diseases has been identified as the remainders of two atomic bombs dropped during the Second World War. Years later the US government was forced to indemnify the victims.

⁶ All islets and “rock islands” that cover an area of less than 200 acres and being washed by winter waves belong to the Greek state.

⁷ During the years 1982-1986, 1100 pheasants, 20 wild goats and 26 wild sheep were left on the island and thus, nowadays the total population reaches an average of 700 animals.

⁸ The shape of the lighthouse of Sapienza is octagonal with a height reaching 18m and has been built by the British in 1890. The lighthouse can be observed from a distance of 27miles. In 1989, a new mechanism was placed allowing the use of solar energy in order to operate automatically.

⁹ The president of the Chamber of Environment and Sustainability M. Dekleris stated that “these islets are differentiated from small islands. They are tiny and isolated bio-systems. They are regarded as extremely fragile ecosystems and they do not tolerate any human presence”. According to the Rio Declaration on Environment and Development (1992) and the Agenda 21: “they are defined as fragile ecosystems. Their survival is threatened with extinction, if any factor disturbs the natural balance in their ecosystems”.

¹⁰ The total area of these islets is less than 500 acres, they possess a high ecological interest (Natura Network) and their position is more than 4n.m. in distance from other islands or the mainland with an average population of 2.000 residents.

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