Tracing Sustainable Island Complexes in Response to Insularity Dilemmas _ Methodological Considerations

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Abstract. In an era of globalization, multidimensional crisis, as well as climate and demographic changes, intense consideration is placed on the identification of development patterns and their spatial counterparts that would alleviate the newly emerging inequalities among regions; and allow sustainability and resilience objectives of their ecosystems to be reached. Insular regions and small islands in particular are critical spatial entities in this respect, as lagging behind regions confronted with a range of contemporary risks and challenges. These raise concerns for spatial planning and policies that are capable of dealing with their geographical specificities. However, issues of conceptual clarification and methodological approach regarding as to the insularity phenomenon remain rather open at the official planning scene. The problem lies in the lack of a multifactorial assessment of islands' dynamics and determination of their area of influence or their dependence on powerful insular/mainland territories. Focusing on the Aegean insular territory, it is investigated whether, and under what conditions, isolation or relinquishment of small islands can be prevented, and smart sustainable development can be ensured. The answer is sought in the leveraging of their competitive advantages as a ground for endogenous development and their organic inclusion in broader spatial, sectoral, and social networks of supralocal/supranational reach.

Keywords: Territorial planning and sustainable development · Blue economy and maritime spatial planning · Natural- cultural heritage · Fragmented insular regions · Small islands · Collaborative networks and smart communities

1 Framing the Discussion

In the territorial cohesion policy of the European Union (EU) emphasis is placed on the development of regions suffering from environmental downgrading, demographic alteration, and severe economic recession (The Treaty of Lisbon, 2017). This category (Article 174 TFEU) includes islands/insular regions, i.e. disadvantaged areas compared to mainland due to their location and their geographical, geopolitical, spatio-functional and socio-economic particularities [1, 2], facing multiple and severe impacts that are established by: a) exacerbation of unemployment and migration phenomena (demographic decline) at *local level*; b) aggravation of intra-/interregional disparities at

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national level, affecting geostrategic stability of countries; and c) intensification of problems during the socio-economic integration process at *supranational level*, hampering the achievement of territorial - social cohesion in the European area.

Island regions are thus confronted with a multitude of *risks and challenges*, raising issues of resource preservation, spatial management, and territorial planning. *Smaller islands* find themselves in a more disadvantageous position, given the inherent (often insurmountable) incompatibilities of their local production base with the quite demanding requirements of the globalised economy, being rather unprepared to venture the necessary qualitative changes assuring long-term development. Problems are intensified in fragmented insular regions where there is a considerable number of *small islands*, mostly of low density, suffering from shortage of key infrastructures. Due to the aforementioned particularities, the Greek insular space with the numerous small, remote/frontier islands presents interest for research and experimentation [1–5].

Unfortunately, despite the increasing research interest and awareness-raising of local governments, agencies and communities, at the EU level there has been no firmly articulated position on the development of insular territories. There is no EU insular law, nor regime or particular status for islands in European law, also no specific funds for islands, except for outmost regions (OR)[1], although islands are confronted with crucial structural and socio-economic handicaps restraining their development. The only exception applies to the Trans-European Networks - an intention that remains still open. As for secondary law, provisions for OR can be permanent [6], whereas provisions for (non-OR) islands may only provide for limited derogations. One such case is small Aegean islands [7], as there are no clearly determined criteria for their selection in the developmental process [8]. Hence, intra-/interregional disparities are enhanced preventing territorial - social cohesion across the geographical levels of the EU [9].

In Greece - a country with the 10th largest coastline worldwide on which the majority of its settlements/cities and a multitude of islands can be found, covering 19% of its territory - the lack of an overall *insular developmental policy* creates numerous problems. Indeed, despite the fact that almost all insular regions (except for Crete) constitute insular complexes (*archipelagos*), many *small islands* have not really been recipients of development efforts due to their satellite relationship with larger islands and/or mainland areas. The reason is that there is no such *developmental policy* for Greek islands and insular regions. It has been more than a decade now that, a *Special Plan for Coastal - Insular Space* was formulated in the country without being instituted.

Currently, crucial issues of: a) conceptual clarification (i.e. *insular region*, *small island*, *insularity*, *peripherality*), b) research methodology regarding the *insularity phenomenon*, and c) *evaluation* and *typological classification* of islands, remain open at the level of official planning. At the EU level the definition of *island regions* remains also controversial, while the definition of an *island* is not as straight-forward as it seems [8] due to the diversity/differentiation of the EU islands in terms of: a) *size* (area,

[1] This category includes: The Azores, Madeira, the Canary Islands, Martinique, Guadeloupe, Reunion, French Guinea (is not an island), Saint-Barthelemy and Saint Martin. Numerous provisions may concern areas such as customs and trade policies, fiscal policy, free zones, agriculture and fisheries, state aid and conditions of access to structural funds [8].

population) as well as building and population density, b) *centrality* of location (geopolitical weight/networking extent), c) *level of development*, which relates to different objectives under the structural funds, d) differences in the *territorial organisation* (network of settlements, land uses), *administrative structure* (system of central/decentralised administration) and *degree of autonomy* of islands and island regions. These are highly critical aspects as they can influence the integration process of *insular regions* (i.e. islands, complexes, regions) into *territorial development policies* and support incentive strategies. At the same time, concepts such as *insularity* and *peripherality* remain rather vague, hindering the prioritisation of interventions and allocation of funding. An equally important hindrance for understanding and addressing the insularity phenomenon is the absence of a holistic, properly documented *methodological approach* in order to assess its multiple dimensions and enable its mapping. Thus, although a fairly extensive and scientifically valid discussion has been elaborated at *theoretical level*, there has been no consensus at the EU level on the principles and guidelines for such a *methodology* to date. As a result, this makes it difficult to resolve issues related to the territorial - social cohesion in insular Member States [10]; while focusing on the Greek case - a top island state worldwide - it is indeed an oxymoron that the above *conceptual - methodological issues* remain unanswered.

In the context of the above discussion, the question arises as to whether, and under what conditions, the *isolation* or *abandonment* of *small islands* can be reversed, and the *smart sustainable development* of their *local communities* can be ensured, being the focus of this work.

2 Research Question and Spatial Reference

Experience has shown that qualitative natural - cultural attributes is the only comparative advantage that *small islands' economies* can have; and specialising in them can be a way out for their development. In this sense, the response to the development of *small islands* could lie in the optimal use of local natural, cultural and human resources [11–13]. However, in a context of intense competition and networking, such an objective can only be achieved through the organic integration of *small islands* into broader spatial, sectoral, and social networks (of a similar or complementary nature) of supralocal/supranational reach. This approach entails the risk that *small islands* may pay the price for their development with environmental degradation and alteration of their *local identity*. Therefore, any attempt to network them with other more powerful islands must be ventured on the basis of *endogenous development*, respecting the *carrying capacity* and *sensitivity* of their ecosystems, and aiming to meet the *real needs* of the local population. How easily can this be achieved in countries with a strongly multi-island character, such as Greece? Given the territorial fragmentation, what mechanisms could avert the abandonment of *smaller islands* and allow them to evolve from *satellites* to *reference hubs* of strong *island entities*? These are questions that cause consideration and division in the absence of a *national insular policy*.

Following the evolution of the Greek *insularity phenomenon*, for realizing its multiplicity and complexity, it becomes clear that the successful integration of *smaller*

islands into potential *insular complexes* (network structure) requires thorough knowledge of their problems and prospects. This is where the problem lies.

Given the circumstances, and acknowledging the importance of adopting a rather *polycentric territorial organisation pattern* at the national level, this article seeks to restore the question of island development to public debate, and re-launch the discussion on the role of *small islands*. Recognising that the island dynamics is not always linked to *size* (area, population), *place in the administrative hierarchy* or *power of economic performance* (such as GDP), it is attempted to highlight other equally important *dimensions or criteria* (i.e. geographical, geopolitical, spatio-functional, environmental, socio-economic) from which new *key performance indicators* (KPIs) could emerge. Thus, a more elaborated approach would enable a comprehensive follow up/evaluation of the Greek *insularity phenomenon*. The missing element from the study of islands is a *thematic database* that would allow ongoing update and multiplex correlation of its data. This should be a multifactorial *pool of criteria* to help drawing conclusions about the level of development of islands and the type of risks and challenges they face. This *pool* could be used as a *tool* to: a) assess the current dynamics of (small) islands and their evolutionary trends; b) highlight and rank local needs/priorities; and c) perform a typological classification of (small) islands and determine the type and importance of their spatio-functional networking among them and with the mainland. Therefore, the proposed *pool* could serve as a *policy instrument* for the Greek insular territory based on three main principles: a) equitable consideration of dynamic and less dynamic islands with comparative advantages; b) consolidation of the necessary correlations between continental and island regions; c) establishment of permanent close links between *territorial - maritime planning* and *sectoral policies*.

In this rationale, the article aims at determining *regional criteria*, which could be embedded into this multidimensional *pool of criteria* and used the proposed *methodology* to: a) identify *small islands* and understand their developmental prospects; b) map the immediate and broader space where *small islands* interact (Greek maritime space, (inter) regional spatial entities, six nautical mile zones); and c) *typologically classify* them with a view to highlighting those that could play a key role in potential *insular complexes-poles*. The contribution of the proposal is considered significant, as its broad logic allows to be applied at all spatial levels (national, intra-/(inter-) regional, local) or at special categories of space (e.g. coastal, mountainous) [14]. Setting the Greek maritime space as the spatial level of reference, the interest is placed on *smaller islands*, with an emphasis on the *frontier Aegean islands*. The latter constitute a fragile environment, demonstrating the need for prioritisation and the criticality of establishing specific support strategies at the level of *national insular policy* [1]. Key reasons are: a) the geopolitical weight of the islands; b) the highly fragmented nature of *insular regions* with a vast variety of *islands* and *island complexes* where all types of island economies converge; c) the unfathomable concentration of many small, low-density islands of exceptional natural-cultural value, showing trends of continuous and steady decline in the permanent population, coupled with the development of tourism; d) the coexistence of islands functioning autonomously, or as satellites of adjacent islands, or as parts of broader island groups, or developing relations with neighbouring countries (often stronger than those developing with the mainland of Greece).

3 Research Methodology

The scope of the article is approached by two mutually reinforcing levels of research (A and B) (Fig. 1), aiming at working as a basis to feed the debate as to the identification of *insular complexes* in the Aegean, where *small frontier islands* will play a key role. *Level (A)* deals with the study of the specific characteristics of *island regions* and their management/planning. The focus is on *concepts and typologies* of insular areas as well as *contemporary approaches* for *insular development*. *Level (B)* is dedicated to Greece and it is implemented in two *stages*. Having identified the deficit of a *national insular policy*, the *first stage* aims at formulating a proposal on the assessment of *small islands* based on *regional criteria*, and at *typologically classifying* them in such a manner so that potential *insular entities* in the outermost Aegean area to be highlighted. The *second stage* presents the findings in a way as to re-open the discussion of how these *entities* could act as new *development poles* of national importance, where *small islands* would take on the role of *reference hubs*. More specifically:

- *Phase A* attempts to establish a *pool of assessment criteria*, falling into *seven main themes*, namely: (i) *geographical location*, indicating the islands' centrality/geopolitical significance (central, remote, outermost); (ii) *locus*, highlighting environmental/territorial characteristics (e.g. geomorphology, climate, residential network, density); (iii) *nature - culture*, identifying specificities of high local value (history, cultural heritage, protected areas); (iv) *population* (size, social structure); (v) *local economy and production sectors* (primary, secondary, tertiary, economic specialisation); (vi) *accessibility and networking* (transport/communications networks); and (vii) *services and infrastructures of supralocal reach* (administrative, technical, social). These are deliberately selected and can assess the competitiveness of *small islands* in the national/international arena. The *geographical location* coupled with *locus* features bring out significant specificities for the islands' political/economic weight. The *population size* indicates islands' dynamics, especially when correlated with *locus* and *local economy and production sectors*. A competitiveness criterion is also the existence of high-quality *services and infrastructures of supralocal reach*, especially in the fields of administration, education, health care and culture. *In case of small islands, it is highly important to strengthen their centrality and take on board the criteria of nature - culture and accessibility - networking*. The division of the proposed themes into subsections highlights the qualitative differentiation of the criteria, and showcases their quantitative importance. Selection of criteria has also taken into account their capacity to generate measurement indicators.
- In the *Phase B*, the criteria that fit the scale and specificities of *small frontier islands* are selected from the *pool* emerging in the *first phase*, in order to proceed to their *typological classification*. This is attempted by successively implementing two *investigation procedures*, the results of which are illustrated per successive *phase*. The first *investigation procedure* pertain to the generation of three tables (Tables 1, 2 and 3), in the form of checklists, listing from the selected *pool of criteria* what exists - and what does not exist - on each island, and to what extent. More specifically, Tables 1 and 2 *allow for observations regarding the centrality and*

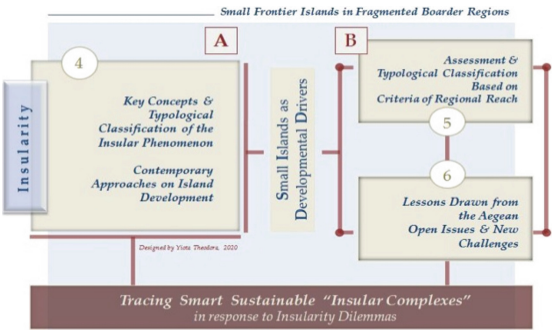

Fig. 1. The Main Levels of Investigation (designed by Yiota Theodora, 2020)

infrastructure of small frontier islands, while Table 3 *illustrates island assessment criteria*. The second *procedure* is implemented in two *stages*, namely: *Assessment A*- assessment of quality criteria; and *Assessment B* - consideration of the quantitative differentiation of qualitative criteria. This *last phase* is concluded with *the identification of potential insular complexes in frontier areas of the Aegean Sea* (Sect. 5).

It should be noted that, in the context of the ongoing investigation: a) in the absence of an official definition of *small island*, the selection criteria are an area of <96 km^2 and a permanent population of <8,000 inhabitants. In addition, islands must constitute municipalities; b) *frontier islands* are considered to be those bordering another country on at least one side; c) *small islands* were mapped at national level to ensure the follow up of their development prospects in close correlation with their immediate and broader environment. The themes of the maps are in line with the proposed *assessment criteria*. Emphasis is placed on *locus*, *nature - culture*, *population*, *local economy - production sectors* (tourism), and *accessibility - networking*; d) the identification of potential strong *insular complexes* is attempted at the *frontier area* of the Aegean (at the borders with Turkey). In particular, *small frontier islands* of the north-east and southern Aegean *island regions* (the Dodecanese) are selected; and e) official data from national, European and international bodies were used to draw up tables and maps.

4 Insularity and Smart Sustainable Development in an Era of Network Organization

In this section, key *concepts and typological classifications* of insular areas are briefly presented while *contemporary approaches* on island development are highlighted.

4.1 Key Concepts and Typological Classifications of the Insular Phenomenon

At the *theoretical level*, an interesting discussion is developing on whether *islands* are a structural spatial entity for the implementation of regional analysis and policy. The

problem is that, thus far case studies have mostly tackled *island states* or *tropical islands* of the oceans and much less *island regions* of the EU. This creates certain gaps in terms of: a) *conceptual definitions - approaches* to anthropological and socio-economic theories regarding the development and sustainability of *islands* and *island regions*; and b) establishment of *methodologies* for research and assessment of their characteristics/problems. Unfortunately, *island regions*, which are under the administration of a largely continental state (most island states of the EU), does not seem so far to have been as elaborated to the extent that it should have been. The same holds true in case of *small islands*, which are missing from census and economic analyses, unless they are considered sufficiently *"large"* to be included in reviews/ inspections of EU regional policy. Such findings are of exceptional importance for Greece as an *island country*.

The literature is rife with *approaches* relating to the *insular phenomenon* and the *typological classification* of island regions. *Island* is defined as any small part of land provided that: a) is surrounded by water (regardless of whether it is in a river, lake or sea); b) has been naturally created; c) protrudes from the surface of the water and is not covered during the tide; and d) it can support housing and economic activity, a condition that could differentiate an *island* from an islet or rocky islet. *Island complex* means a group of *islands* belonging to a single geographical area, without necessarily developing interdependencies. *Island region* implies a large island or a group of islands with similar natural and socio-economic features and problems. At the EU level, Structural and Cohesion Funds Article 52 of EC Regulation No 1083/2006, *islands* are defined as *Island Member States eligible under the cohesion funds and other islands except those on which the capital of a Member State is situated or which have a fixed linked to the mainland* [15]. This definition is based on the following criteria: a) minimum surface area of 1 km^2; b) minimum distance between the *island* and the mainland of 1 km; c) resident population $\geq$ 50,000 inhabitants; and d) no fixed link (bridge, tunnel, dyke) between the *island* and the mainland. *Island regions* have been defined by the European Commission as regions in which a substantial part of their population lives on islands or a large fraction or their territory is islands. *Island regions* account for 53 NUTS 3 in the EU, all with different degrees of *insularity*, with some of them completely insular (100% of the region's population lives on islands). In this case the NUTS 3 region can correspond to one *island* (Sicily, Sardinia) or the NUTS 3 is an *archipelago* (e.g. the Greek Archipelago Regions, and the Azores) [8]. Diverse views are also developed on the *typological classification* of *island regions*, highlighting different aspects depending on whether the criteria are physical (area, physical characteristics) or anthropogenic (e.g. population, density, level of development, administrative structure); whether they focus on quantitative or qualitative characteristics; and whether they are simple or complex. Two factors causing problems in the *classification* of *islands* are the: a) almost exclusive use of the area or the population, as the *size* is not always linked to the competitiveness of an *island*; and b) adoption of a single criterion (especially population size). Thus, estimates/classifications using concepts such as *small*, *large*, *saturated*, *developed*, *dynamic*, *vulnerable* island raise doubts about their reliability and common understanding, hence the effectiveness of their use in developmental policy-making.

In such circumstances of broader ambiguity, two critical, equally unclear concepts to the monitoring/assessment of the *island phenomenon* are *insularity* and *peripherality*. *Insularity* reflects the degree of isolation of an *island* resulting from its location in relation to the nearest continental land. Its assessment parameters are *distance*, *intensity* and *size of flows*, and *population distribution* weighted by potential economic capacity. *Peripherality* - one of the most widely used concepts in terms of *island development* - is traditionally related to the: a) *distance* from central developed areas; b) degree of *accessibility*; and c) dynamics of the *collaboration relationships* through developing networks for the flow of goods, people, capital, as well as the level of development of each of these networks and the degree to which they are depended on decisions taken in other more central areas of insular or mainland space. It is usually measured by the average travel time index, i.e. average travel time to a main centre of economic activity of the EU by a means of transport or by a composite indicator derived from economic (per capita GDP) and geographical (distance) indicators [16].

4.2 Development of Islands and Island Regions

Insular areas constitute special *spatial category* due to their particular features, which become reasons for geographical and socio-economic isolation and for increasing inequalities at a local or regional level. These features are also encountered in *spatial entities* within developed areas. However, in *insular areas* their concentration/potency are far greater, particularly in instances of *small/remote islands*. In such vulnerable loci, there are many factors which should be evaluated as part of *developmental policy* and counted during the *planning process*, namely: a) *spatial factors* that concern geographical position and the features of their natural/manmade environment; b) *demographic factors* (e.g. ageing population, limited dynamic, seasonal variation in population); c) *economic factors* linked mainly to supply and demand, high production cost and small market, insufficient work force skills, deficient investments and seasonal activities (e.g. tourism); d) *social factors*, mainly related to insufficient technical/societal infrastructures and services. In fact, every *island*, no matter how small, requires a full set of infrastructures and services, necessary for its development. However much of this might not be justified by its population size. No *island* can depend on the infrastructures of a developed neighbouring area, particularly when said *island* is isolated [1].

In the case of EU, diversity of insular regions sets special conditions. This diversity is mainly expressed through the: a) high concentration of population on a few *islands* and a very large number of less populated *islands*; b) population from 50 to 5,000,000; c) surface from 1 km^2 to over 25,000 km^2; d) distance from the mainland from less than 1 km to 1,450 km (e.g. Azores); e) service sector is pivotal for the development of *islands* especially tourism; f) economic growth capacity of *islands* is usually limited due to the small size of local markets and the distance to larger mainland markets, especially for less populated *islands*; and g) distinct natural and cultural environment [8]. Indubitably, *islands* are exceptionally fragile environments of multi-factorial *peripheralisation*, which renders them vulnerable. The territorial multiple dispersion of *insular territories*, the heterogeneity of their segments (size and dynamics) and the differences in the relationships among them (i.e. kinds, quality, frequency of flows and

networks) as well as the extent of their dependence on the continental space, in conjunction with the variety of inherent weaknesses/developmental prospects compose a field where crucial matters that should be dealt with co-exist. *The development of these peculiar insular regions must necessitate a special methodology for research and spatial regulation and allow for the simultaneous approach of general and special matters.*

Various approaches have been set out to address the specificities of the *insular territory* and develop its parts. On a *theoretical level*, the *classical regional development theory* applied to island regions ranges between the dependency principle of the *centre-periphery model* (Myrdal) and the *neoclassical theory of comparative advantage*. In *classical theory*, *island* underdevelopment is interpreted by the predominance of backwash over spread effects. The *neoclassical theory* found fertile ground in the interpretation of the underdevelopment of *small spatial entities*, such as *islands*, whereby the degree of resource scarcity or abundance has ultimately determined their dynamics. In the context of the two theories, the debate on *regional policy* tends to be structured around three positions, namely: a) *top-down* development in the form of centralised policies focusing on the introduction of capital and technology in a region and aiming at the development of infrastructure and investment attraction; b) *endogenous* or *bottom-up* development, based on decentralisation, local decision-making and new job creation, while focusing on leveraging their *competitive advantages*; and c) establishment of strong *networks for cooperation & exchange of experience* among regions with shared problems, in line with the logic of *endogenous development*. At the EU level, the last two positions are supported for the planning of spatial (territorial and maritime) and sectoral (e.g. rural, tourism, environmental, energy, transport) policies, with a view to increasing competitiveness in *declining island regions*, and restructuring the most problematic ones. After 1990, this discussion has been enriched with variations of previous *concepts*, such as *sustainable development* and *smart growth*, which underscore the protection of the natural - cultural environment as well as the use of human resources and new technology [17–22]. Despite weaknesses, the contribution of all views has strengthened the debate through the introduction of critical parameters that need to be considered in the *economic analysis - planning* of *island regions* [23].

5 Evaluation and Typological Classification Based on Criteria of Regional Reach _ the Aegean Small Frontier Islands

Greece is among the countries with the largest number of islands in the world. The multi-island structure coupled with the fragmentation of its *insular regions* make the Greek *insular phenomenon* quite unique. The Greek *islands* belong administratively to four purely *island regions* (three are located in the EU's external borders) and eight continental regions with insular sections (*Kallikrates*, Law 3852/2010). Of the purely *island regions*, the South Aegean (i.e. Cyclades and Dodecanese *archipelagos*) comes first comprising the largest number of *islands*, 34.38% of the total island territories and 26% of the country's total coastline, followed by Crete (12.44%), the Ionian Islands

(9.65%) and the Northern Aegean (4.49%). Of the continental regions, Attica has the largest island Sect. (16.12% of its region), Epirus the smallest (0.04%) and Western Macedonia none at all. According to a synthetic assessment of demographic and socio-economic indicators, Crete and the South Aegean region are the most dynamic *island regions* with a favourable sectoral structure and positive local factors. They are followed by the Ionian Islands and the Northern Aegean regions, which have a weak or unfavourable sectoral structure and negative local factors, with the declining trends having reversed after 2001.The *frontier island regions* of the North and South Aegean (research spatial scope) are characterised by: a) lack of agricultural reorientation with strong trends of sectoral reorganisation and professional specialisation (as per case), b) weaknesses in the secondary and tertiary sectors, tourism monoculture trends, and c) infrastructure deficiencies (productive, technical, social). Specifically for *small islands*, the contacted research identified 32 cases in seven of the country's thirteen regions. Their share in the total Greek insular area and national territory is 6.97% and 1.14%, respectively. Of the 32 *small islands*, 16 belong to *frontier island regions* (i.e. Northern Aegean: 3; South Aegean (Dodecanese): 10; Crete: 1; Ionian Islands: 2) with the 14 of those located in the outermost parts of the Aegean (border with Turkey). (Fig. 2)

In the absence of a reliable system for the *evaluation* and *typological classification* of *island regions* at national level, the aim is to introduce a different dimension to the monitoring and assessment of island dynamics. Emphasis is placed on the correlation of quantitative and qualitative variables based on a multi-dimensional approach which takes into account regional criteria capable of capturing the nature, number and intensity of the islands' relations with each other, and with mainland regions, thereby highlighting the sustainability of their local communities. The proposal, which is theoretically based on the concepts of *polycentric development and network spatial organisation*, consists of a specific scientific approach which, without eliminating quantitative data, or the quantitative dimension of qualitative variables, uses them in a subsequent *phase* to complement the picture resulting from the assessment of the qualitative variables and the way they are combined. The proposal has research interest since it demonstrates in practice that *spatial entities* increasingly take the form of *island combinations* (dipoles, polypoles) rather than autonomous *islands*. This trend necessitates the identification of *hub islands* and their interconnections (*axes-flows*).

To evaluate the dynamics and perform a *typological classification* of *small frontier islands*, subsets of seven proposed criteria sets (Sect. 3) are selected on the basis of their suitability for the scale of these islands. The thematic subsets are: (i) *geographical location*: cross-border character (distance from neighbouring country); (ii) *locus*: area (km^2), number of settlements, density (inhabitants/km^2); (iii) *nature - culture*: historic/remembrance sites, natural-cultural heritage features, protected areas; (iv) *population*: permanent population (1991, 2001, 2011), % population change; (v) *local economy - production sectors*: % change in economic activity by sector (2001–2011), % change in beds (2009–2019); (vi) *accessibility - networking*: Multi-modal Hub (MH: port and airport); (vii) *supralocal services - infrastructure*: in sectors of administration (A), military (M), healthcare (H), education (E), culture (C), and other (o). Three thematic tables are organised to best monitor the process. The islands are presented by *region/ regional unit* (from north to south), and by *size*, starting with the smallest in area. Specifically, Table 1 combines criteria from the thematic of

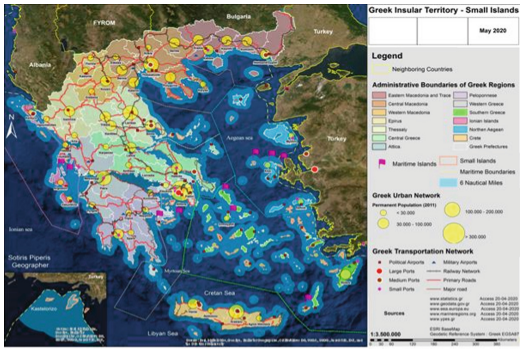

Fig. 2. Greek Insular Territory - Small Islands (Source: Sotiris Piperis, May 2020)

(i) *geographical location*, (ii) *locus*, (iii) *nature-culture*, and (vii) *services - infrastructures of supralocal reach*; while Table 2 reflects (v) *local economy and production sectors* and (vi) *accessibility -networking* criteria. Both tables provide data on administrative structure, population, area, density (population/area) and urban structure (number of settlements). Table 3 (being a product of a synthesis of Tables 1 and 2) illustrates the *island assessment criteria* divided into *six themes*: (i) *geographical location*, (ii) *locus*, (iii) *nature -culture*, (iv) *population*, (vi) *accessibility - networking*, and (vii) *services and infrastructures of regional reach*. The criteria for *area* (<5, 25–50, 50–96), *population* (500 < 500–1,500, 1,500–3,500, 3,500 >), *density* (20< , 20–50, >50), and *supralocal infrastructures-services* (1–2, 3–4, >5) are divided into categories (Fig. 3).

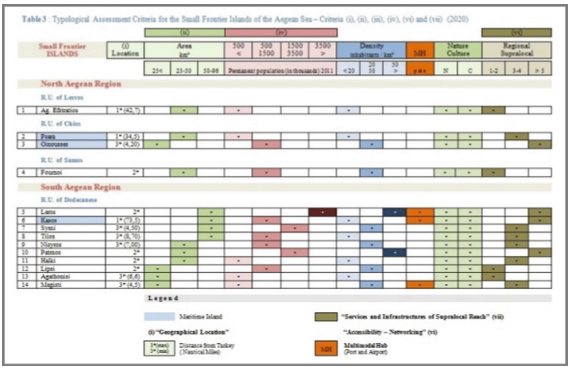

Fig. 3. Typological Assessment Criteria for the Aegean Small Frontier Islands

Because sufficient size is desirable, but it is the hub function of *islands* that is most interesting, the information from Table 3 is evaluated in two *phases*:

- In the *first phase*, emphasis is on the *centrality* of location. Interest is thus basically focused on whether the following three subsets are present: (iii) *nature - culture* (historic/remembrance site, maritime island, quality of natural-cultural heritage), (vi) *accessibility - networking* [(MH), connection with Turkey and neighbouring island of administrative dependence (seat of regional unit/prefecture)], and (vii) *services and infrastructures of supralocal reach*.
- In the *second phase*, the size of the *centrality* is also of interest. Therefore, account is taken of the (iv) *population* sub-groups (500< , 500–1,500, 1,500>), and the quantitative differentiation of the qualitative criteria: (i) *geopolitical location* [distance from Turkey: 1* (max), 2*, 3* (min)], (vi) *accessibility - networking* [(MH), connection with Turkey and frequency of connection to the neighbouring *island* of administrative dependence (seat of regional unit/prefecture): 1–2, 3–5, 6–7 per week), and (vii) number of *services and infrastructures of supralocal reach* (1–2, 3–4, 5>).

The findings drawn from the *assessment* and *typological classification* of the *Aegean small frontier islands* are summarized below in such a way as to re-think their contribution to the creation of new dynamic *insular entities - poles* of supranational reach.

6 Building Sustainable Island Complexes in the Aegean Sea _ The Small Frontier Islands as a Key Factor

The assessment of *small frontier islands* delivered a first impression of their dynamics/perspectives, which was subsequently enriched with their *typological classification*. This has brought to the fore those *islands* that, according to the proposed *criteria*, could serve as *hubs* in the potential *insular entities*. With regard to the developmental impression of the *islands*, the following are noted per criterion:

- They are all *frontier islands*. However, some are more remote due to their location (long distance from Greek mainland, short distance from Turkey) or more isolated [geographical or actual distance (networks and frequency of connections to neighbouring islands)]. This raises issues of security, priorities and perspectives; Ag. Efstratios, Psara, Agathonisi and Lipsi are in a more unfavourable position, whilst Leros (Kalymnos), Halki and Symi (Rhodes) and Oinousses (Chios) in more favourable. Patmos and Megisti, despite their geographic distance from dynamic *islands*, are not considered isolated, due to good transport networking;
- 71.42% of *small islands* have an area <50 km^2. The most remote islands are Oinousses (4th smallest, 18 km^2) Agathonisi (2nd smallest, 14 km^2), Nisyros and Megisti (the smallest, 12 km^2). The islands with the largest area are Leros and Kasos, both multimodal hubs, with negative % change in the primary sector, positive in the tertiary and considerable unemployment rate;
- All islands have a rich natural-cultural heritage on land and at sea (marine archaeology, underwater caves, shipwrecks) and belong to the Natura 2000 network of protected areas. Psara, Kasos and Oinousses are *maritime islands*, i.e. they have a significant maritime history and a strong orientation to the shipping/shipbuilding

sectors. Among remembrance islands are the first two heroic loci and Ag. Efstratios (exile island), while Patmos is well known for its religious character;

- Leros is by far the *island* with the largest population, followed by the smaller (in area) Patmos and Symi islands. The majority of *islands* (78.57%) have population <1500 inhabitants. Ag. Efstratios, Psara, Agathonisi, Halki, Megisti have a population <500 inhabitants. In period '01-'11, 50% of the *islands* demonstrated an increase in permanent population, with the most important noted in Halki and Nisyros. Population decline is observed in five *islands*, with Ag. Efstratios rating first (−12%), followed by Psara and Oinousses (which in period '91-'01 had a spectacular increase of >40%, as did Tilos and Megisti). 85.71% of *islands* are equally divided between the low (<20 inhabitants/ km^2) and medium density (20–50 inhabitants/km^2) categories. Leros (105.56 inhabitants/ km^2), Patmos (67.71 inhabitants/km^2), Lipsi (46.47 inhabitants/km^2), Oinousses (45.89 inhabitants/km^2), Megisti (41.0 inhabitants/km^2), Symi (39.84 inhabitants/ km^2), and Fournoi (31.71 inhabitants/km^2) have the highest density. It is clear that a *density problem* is encountered not only in *islands* with the largest area and population (Leros), but also in the medium-sized i*slands* (25–50 km^2) with a population of 500–1,500 inhabitants (Fournoi, Nisyros), or a population of 1,500–3,500 inhabitants (Patmos), as well as in smaller *islands* (<24 km^2) with a population of 500–1,500 inhabitants (Oinousses, Lipsi), and even in the smallest ones with a population of <500 inhabitants (Megisti). Agathonisi belongs to the category of very small, low density islands (<24 km^2, <500 inhabitants), while among the low density islands (25–50 km^2, 500–1,000 inhabitants) are Tilos and Kasos;
- The highest unemployment rates (>50%) in period '01-'11 were noted in Halki, Psara, Leros, Ag. Efstratios, Kasos and Agathonisi; Oinousses have been an exception (60% reduction in unemployment). The largest % decrease in the primary sector has been recorded in Fournoi, Ag. Efstratios and Patmos, while the largest increase in Megisti and Nisyros. Oinousses and Megisti have a positive % change in the secondary sector, while Psara and Tilos have a negative one. A positive % change in the tertiary sector is seen in Agathonisi, Lipsi, Psara, Symi and Kasos. In the tourism sector (index: % change in beds '09-'19), the largest positive change is found in Psara (46%), Tilos (37%), Halki (16%) and Megisti (9%) and the largest negative in Kasos (−27%);
- Multimodal transport hubs (i.e. port and airport) are Leros, Kasos, and Megisti. The first two belong to the islands with the largest areas, while Megisti to those with the smallest area (<24 km^2). Kasos (a *low-density island*) has the shortest flight duration (Karpathos). All *islands* have heliport to serve in case of an emergency. The best networked *islands* with their neighbouring island of administrative dependence (seat of regional unit/prefecture) are Oinousses (Chios), Leros and Lipsi (Kalymnos) with a daily connection; followed by Symi (Rhodes) and Ag. Efstratios (Limnos) with 5–6 days/week; Psara (Chios), Agathonisi (Kalymnos), Halki/Megisti (Rhodes) with 2 days/week; and Fournoi (Ikaria) with 1 day/week. Leros, Symi and Megisti have connections to Turkey and Oinousses and Patmos only during the summer. For better assessing islands' networking the following (at a next *stage*) will be studied per *island*: type (direct, transit), spatial reach (local, (inter) regional, national), seasonality, frequency and quality of connections;

- All *islands* have a town hall, while only Patmos and Leros have Healthcare centres of supralocal reach. Oinousses (*Merchant Marine Academy*, *Maritime Lyceum*) and Patmos (*Patmiada Ecclesiastical School*) have education infrastructure of supralocal reach. The highest concentration of cultural infrastructures is found in Oinousses, Patmos, Leros and Kasos, while only limited is in Ag. Efstratios, Fournoi, Agathonisi and Lipsi.

With regard to the *centrality* and degree of networking of *small frontier islands*, two ranking assessments emerged from the proposed *typological classification*. Islands are noted from north to south. In *Assessment A*, based on the *qualitative approach* of the proposed criteria (i.e. what exists and what doesn't exist on each island), *small islands* are divided into three categories, namely of: a) *major importance* Ag. Efstratios, Psara, Oinousses, Patmos, Leros, Symi, Megisti, b) *medium importance* Nisyros, Halki, Kasos, c) *minor importance* Fournoi, Agathonisi, Lipsi, Tilos. The ranking changes when *population* and the *quantitative differentiation* of the *quality criteria* are taken into consideration in *Assessment B*. Thus, the following categories of *small islands* emerge: a) *national/interregional reach* Patmos, Leros and Symi (>1,500 inhabitants, infrastructures >5), b) *regional reach* Oinousses, Fournoi, Nisyros, Tilos, Kasos (500–1,500 inhabitants, infrastructures 3–4), and c) *local reach* Ag. Efstratios, Psara, Agathonisi, Lipsi, Halki, Megisti (<500 inhabitants, infrastructures 1–2) (Fig. 4).

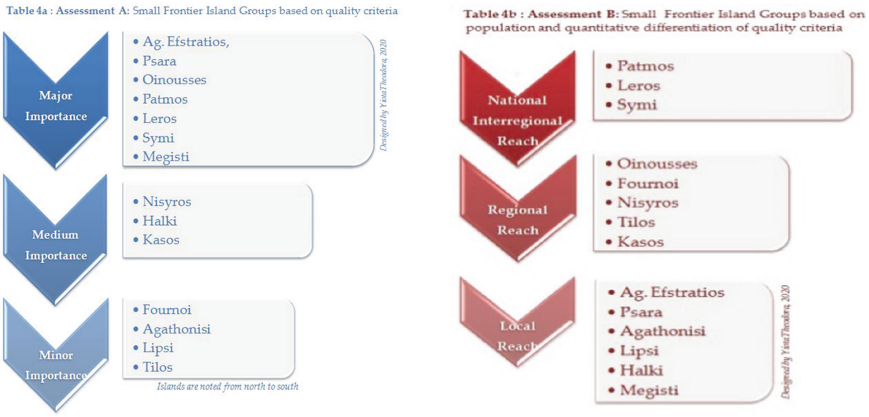

Fig. 4. SmallAegean Frontier Island Groups from the Typological Classification

In an effort to compare the results of the two rankings, it becomes evident that when the *population size* is taken into account, changes in the ranking may emerge, confirming the dominance of the *"largest" small islands*. However, the dynamics of an *island* is not necessarily related to the *size* of its population or area [(Leros, Oinousses (MH, infrastructure >5)], but rather to its *density* [Kasos (MH, infrastructure >5), Megisti (MH, infrastructure >3)] coupled with *accessibility and networking* (Oinousses, Megisti < 24 km^2 and MH) and the existence of *supralocal infrastructure* [(Leros

(>5), Patmos (>5), Oinousses (>5)]. Therefore, the value of this proposal is more relevant for *small islands* belonging to the middle and small categories of area and population, for which the results regarding their importance are different, due to their natural and cultural wealth, good networking and the existence of infrastructures of supralocal reach (Oinousses, Megisti).

Concluding the search trail, *small frontier islands* that are particularly dynamic and could the first to play a key role in the formation of dynamic *insular complexes* in the Aegean (from north to south) are Oinousses, Psara, Patmos, Leros, Tilos, Symi and Halki. By strengthening their already strong networking with the neighbouring large and *smaller islands* of the broader region, they could act as a catalyst for the creation of three powerful *potential networks*, thus helping to reduce inter-regional disparities and strengthen Greece's position globally. Through the networking of *larger/smaller islands* as part of an overall *insular policy*, three new dynamic *developmental complexes-poles* could arise, namely: (I) Chios - Oinousses - Psara; (II) Patmos - Leros -Kalimnos - Kos; and (III) Rhodes - Simi - Halki - Tilos. To determine the nature and role of these new *entities* at a national level, it would be necessary to be investigated at lower levels of *planning* in order to set up the appropriate *research - demarcation methodology*. Steps are taken to this direction and initial results are expected shortly.

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