The need for the implementation of an Ecosystem Services assessment in Greece: drafting the national agenda

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Abstract

This paper presents the establishment and the first outcomes of the Hellenic Ecosystem Services Partnership (HESP), a scientific-technical committee aiming at the guidance and coordination of the Ecosystem Services (ES) assessment in Greece. HESP consists of experts from different disciplines (ecology, marine biology, socio-ecological system science) and aims to: i) coordinate ES assessment efforts under a shared framework; ii) promote the ES approach in Greece; iii) support the European implementation of ES at the national level (Mapping and Assessment of Ecosystem and their Services initiative), and iv) fulfill priority actions regarding the ES implementation and the obligations derived from the National Biodiversity Strategy. In this paper, we present the first drafting of the National Agenda including short- and long-term objectives towards the national implementation of MAES, we outline the HESP Action Plan to 2020, as well as the timeline of the basic steps to be taken, to achieve decision making on the basis of ES maintenance and enhancement. It will also serve as a call for action to encourage more ES assessments at the national level, but also as a primer for the inclusion of protected areas and other areas of special importance for ES assessments at the EU level.

Keywords

Ecosystem service mapping; IPBES; Knowledge overview; MAES; National biodiversity targets; NBSAPs; National Committee

1. Introduction

The Greek peninsula, as part of the European Union (EU) territory, is a highly heterogeneous environment, hosting a high diversity of species and ecosystem types. This fact is rendered through the 419 established Natura 2000 Network sites in Greece, which host 91 habitat types (82 terrestrial and 9 marine) of Annex I of Directive 92/43/EEC (out of totally 233 Habitat Types of the Directive) and 112 flora and fauna species of Annexes II, IV and V of the same Directive (Ministry of Environment and Energy 2015, unpublished data available upon request). Moreover, there are 30 habitat types unique for the Greek territory, which are not included in Annex I of Directive 92/43/EEC (Dimopoulos et al. 2006). Greece is also one of the most mountainous countries in the Mediterranean and the Balkans with 65% of its surface covered by mountainous areas. These areas are mainly characterized by intense spatial fragmentation and a great degree of landscape heterogeneity – given the area they occupy (Vlami et al. 2012). Additionally, the Greek territory is dominated by the sea element with more than 1400 islands or islets (of which around 200 are inhabited) and 13600 km of coastline (the longest in the Mediterranean region). Its extensive coastline comprises several landforms, such as rocky shores, cliffs, coastal lagoons and deltaic systems (Anagnostou et al. 2005), and the marine realm has a great variety of habitats and geomorphological features such as shallow shelves, deep basins, and troughs (Sakellariou et al. 2005).

Since the 1950's Greece has experienced changes on all levels of economic, social, and environmental sectors; the impacts of this growth have decayed local resources and jeopardized the country's environmental sustainability in the long term (Dimelli 2016, Dimelli 2017). Recently, the economic crisis has led to a declining importance of environmental issues in the public perception, reduced funds for conservation and research, an acceleration of efforts to turn environmental assets into subsistence goods or marketable commodities (Apostolopoulou and Adams 2014, Calvário et al. 2016, Petrakos and Psycharis 2016), a reduction of environmental safeguards (e.g. due to policies to promote investments through fast-track laws), and an increase of poaching and other illegal activities (Katsanevakis et al. 2015). Hence, concerns are raised about how natural resources could be utilized for ensuring future sustainability of their services and promote growth under the need of the current geo-political situation in Greece (Giannakopoulos and Anagnostopoulos 2016, Psycharis et al. 2014). Besides the economic crisis, the ongoing climate change adds another layer of complexity on natural resources management and spatial planning for future sustainability (Santamouris et al. 2015, Voloudakis et al. 2015).

The global scientific community has acknowledged the importance of maintaining environmental resources and ecosystems in good condition to provide ecosystem services (ES) for human well-being. These issues reached the EU environmental policy agenda in the 2000s (e.g. Millennium Ecosystem Assessment 2005, T.E.E.B. 2010, EASAC 2009, CBD 2010), following the international environmental discussion (e.g. de Groot 1992, Daily 1997, Costanza et al. 1997). Moreover, development agendas are

known to involve conservation of ES (Galaz et al. 2015), a factor which now, more than ever, should be taken into account in environmental management. Following these approaches on environmental management and in line with the Millennium Ecosystem Assessment (2005), EU included and prioritized the ES concept under Action 5 of Target 2 of its Biodiversity Strategy to 2020, calling on Member States to map and assess the state of ecosystems and their services (MAES).

While ES are recognized and discussed extensively by the Greek government in its National Biodiversity Strategy and Action Plan (NBSAP) as part of Greece's obligations to the Convention on Biological Diversity (CBD), this does not translate into cross sectoral regulatory and institutional frameworks to date. Along with the EU Member States (MS) within MAES, Greece has to assess and map its ecosystems and the ES they deliver, as well as to make an economic value assessment integrating its natural capital into accounting and reporting systems at a final stage. Only a handful of EU MS have conducted a full or partial MAES study so far and while Greece has taken the initiative to start the process, it has been put on hold for the time being.

In Greece, until recently, when the National Biodiversity Strategy was approved and adopted (Hellenic Ministry of the Environment, Energy and Climate Change 2014), there was no action targeting to restrain both biodiversity loss and ES degradation. The country's natural heritage is protected with the designation of natural parks and protected areas (e.g. the establishment of the Natura 2000 network, national parks and the Ramsar Convention for wetlands). As a result, the Prioritized Action Framework (PAF) for the Natura 2000 area in Greece (Hellenic Ministry of the Environment Energy and Climate Change 2014), has been established, where its Strategic Priority F.3 emphasizes the value of ES conservation and of the significant natural (and cultural) capital of these areas to the economy of the country and particularly to two fundamental sectors: a) tourism, by reinforcing the added value of the offered tourist product; and b) the primary sector, by emphasizing the integrated management of the agricultural production and its contribution towards the conservation of ecosystem services and biodiversity.

On the other hand, the scientific community of the country has always been developing knowledge on ecosystems and their sustainable use for development, with many recent studies considering the ES concept to their discussion (e.g. Katsanevakis et al. 2014, Oikonomou et al. 2011, Salomidi et al. 2012, Vlami et al. 2017), taking into account also the socio-economic component (e.g. Zomeni et al. 2008, Latinopoulos 2014, Skourtos et al. 2009).

To support the implementation of the MAES in Greece, to fulfill PAF's targets regarding ES and National Biodiversity Strategy's obligations (Hellenic Ministry of the Environment, Energy and Climate Change 2014), and to contribute to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) regional assessments in the future (Schmeller et al. 2017), a working group has been established to act as a Partnership for studying, implementing and promoting the ES approach in Greece. This group, named as the Hellenic Ecosystem Service Partnership (HESP), as part of the Ecosystem Services Partnership (ESP), will act as a scientific- technical committee

aiming to coordinate ES research and relevant activities in Greece, from operationalization in decision-making to raising societal awareness.

Herein, we aim to present the Hellenic Ecosystem Services Partnership (HESP) and in particular we present: i) an overview of the ongoing ES research in Greece; ii) the HESP scope and goals; iii) the conceptual framework that applies to the national ES assessment at various scales; and iv) the roadmap for the implementation of ES assessments in Greece.

2. Overview of ES assessments in Greece

The first research efforts made in Greece taking into account ES appear in the late 1990s (e.g. Langford et al. 1998, Gerakis and Kalburtji 1998, Zervas 1998). At that time, research did not specifically refer to ES as such, but a significant amount of research was developed applying a socio-ecological systems' approach. Research focused on the economic assessment of environment, or valuation of environmental benefits (Damianos and Skuras 1996, Forbes 1995), or social preferences for improving water quality or preserving biodiversity, but even on agricultural practices that impact ecosystem functions and values (Genitsariotis et al. 2000, Lekakis 2000, Zanias 1998). In the brief literature review we carried out, we noticed a sharp increase in the number of ES related publications in Greece after 2006, in line with global trends of ES research (Gómez-Baggethun et al. 2010). In this review, we detected that the most commonly assessed ES were the provisioning ones, especially those provided by agriculture (e.g. Gerakis and Kalburtji 1998, Zalidis et al. 2004). A significant amount of research focuses also on regulating services and associated functions, especially linked to pollination (e.g. Garantonakis et al. 2016, Petanidou et al. 2008b); less research focuses on regulation of water flows and nutrient filtration (Gerakis and Kalburtji 1998, Jones et al. 2008). The pollination service is of great economic value for Greece and EU (Schulp et al. 2014), with honey bee availability indicating far higher supply than demand for this service in Greece compared to other European countries (Breeze et al. 2014, Potts et al. 2006).

Cultural ES have also been studied in Greece, albeit to a lesser extent. Vlami et al. (2017) identified and prioritized the Natura 2000 protected areas that may require special attention for managing cultural elements-of-diversity that provide ES. Petanidou and colleagues in a series of publications have highlighted the cultural importance of salines and saline landscapes (e.g. Petanidou 2005, and many more in Greek) for the Greek and Mediterranean people. Petanidou et al. (2008a) have also studied the cultural significance of traditional agricultural landscapes in Aegean islands, using cultivated terraces as case studies, while Terkenli (2001) has studied the cultural geography of the Aegean landscape. Vlami et al. (2017)adopted a GIS-based approach to quantify and map the cultural elements of the Greek Natura 2000 sites, concluding that cultural landscapes and human modified habitat types are prominent in the protected area network. Recently, significant work on contemporary sacred sites and trees has been published by Stara et al. (2014), Stara et al. (2016) focusing on sacred forests in Epirus

finding that younger generations were unaware of values attached to trees by previous generations, especially for sacred and traditional uses.

Regarding recreational ES, there have been several studies applying various approaches, but mostly by assessing visitor patterns in different ecosystem types and their links with specific land-/sea-scape features (e.g. Makrodimos et al. 2008). The large amount and diversity of studies related to recreation and nature in Greece is possibly due to large investments the country has made to its tourist industry, since the start of the 20th century, and most significantly after the 1950s (Sohier 2016). Recently, a decline in the demand for recreational ES has been noted by Latinopoulos (2014), who found that the ongoing economic crisis has suppressed expected trips to Nestos River (within the boundaries of the mountainous Rodopi National Park in North Greece) by 15–25%. Attention has also been paid by researchers from the natural sciences, to quiet and tranquil areas in terms of their recreational, tourism and health potentials, both in terms of mapping ecosystems qualities and quantifying their benefits (Votsi et al. 2014a, Votsi et al. 2014b).

There are also specific ecosystem types that are of particular interest for the assessment of their ES. For example, a considerable number of ES research efforts in Greece focus on marine and coastal ecosystem services (MCES). Commercial and recreational fisheries are one of the most important and well-studied human activities in the Greek seas, which is the most important means for food provision by marine ecosystems, but also an activity with a high impact on ecosystems and their services. (Skourtos et al. 2015) put together a database of the Marine ES values, from all over the Mediterranean. Mountain areas are also well studied in the country, as well as their links with ES (e.g. Kokkoris et al, *under review*). A significant amount of research has also been devoted to the uses of native plants, e.g. as spices (Kokkini and Vokou 1989), for health and traditional medicine (Sivropoulou et al. 1996, Clark 2002, Hanlidou et al. 2004), or the food preservation benefits of essential oils (Vokou et al. 1993b).

In terms of methods used for ES assessments, several ES studies were published in the environmental economics literature focusing almost exclusively in the economic valuation of ES and especially on the ES supply (Kontogianni et al. 2010). Contingent valuation methods (CVM), mostly willingness to pay (WTP) for resource management, environmental management and energy/climate change are among the most commonly used ones (Latinopoulos 2015). Other research related to ES assesses the condition and quality of ecosystems, ecosystem functioning and ES using a range of indicator sets. Several research groups focused on estimating non-market values of biodiversity and species or habitats of conservation priority, such as the monk seal *Monachus monachus,* the loggerhead turtle *Caretta caretta* (Kontogianni et al. 2012, Stithou and Scarpa 2012) and *Posidonia oceanica* meadows (Stithou et al. 2017). Other studies examined through choice experiments the public preferences on ES in wetlands (Birol et al. 2006) or for climate change adaptation strategies in mountains (Andreopoulos et al. 2015).

The above-mentioned studies focused exclusively on Greece or on a local case study. But Greece, as an EU MS, is also included in many geographically wider studies. For

example, field experiments and models showed that the soil food webs play an important role in nutrient cycling and agricultural production in Greece and also other countries across Europe (de Vries et al. 2013). Comparing 220 European cities, Larondelle et al. (2014) showed that Greek cities are low in provisioning and regulating services compared to other EU cities. On the other hand Greece has a high amount of areas able to provide multiple ES such as vineyards (Winkler et al. 2017) or High Nature Value Farmlands such as olive groves and rice fields (Gardi et al. 2016). Pest control by vertebrates is another service that has been modeled (using bioclimatic envelop models) and assessed and is considered threatened by climate change (Civantos et al. 2012). But also the supply and demand for abiotic services like coastal protection (Liquete et al. 2013) and flood regulation (Stürck et al. 2014) have been modeled using biophysical and socio-economic variables, and in Greece these services were considered to have more supply than demand compared to the EU average. In Europe, MCES, especially food provision, ocean nourishment, recreation and tourism, and lifecycle maintenance, are highly impacted by biological invasions, with Greece being among the most heavily impacted countries (Katsanevakis et al. 2014, Katsanevakis et al. 2016).

ES research in Greece is conducted exclusively by academia in contrast to other countries in the broader Balkan region where it is conducted mostly by development agencies. Although this indicates that there is expertise on the subject at the academic level in Greece, the awareness of the other societal groups, from decision-makers to the general public is very limited. The number of relevant to ES academic courses and education curricula is still very limited. This short overview (summarized also in Table 1) is not extensive but its role is to give an indication of the type of ES research that has been carried in the country the last decades. It is important to keep in mind that a great deal of environmental research spanning decades, especially in the natural sciences, examined different ecosystem functions and processes (e.g. vegetation, pollination, wood production, fisheries) without reference to these functions as services.

3. Data availability (Biophysical, Socio-economic data)

For ES assessments specific data types are required depending on the ES assessed, the spatio-temporal scale and the method that each assessment demands. For continental or global assessments, many EU and global datasets are available (many of them open access) and could be used as the primary data input for ES studies in Greece. An extensive review of these datasets and how they can be used to map ES is published by EU's Joint Research Centre (Egoh et al. 2012). Besides that, national level accurate data is essential for national and regional ES assessments. Greece has also a vast amount of data on bio-physical elements, but most of them are lacking spatial reference.

3.1. Biophysical data availability

Detailed and spatially referenced data is available for Special Areas for Conservation (SAC) and Special Protection Areas (SPA) and more specifically for habitat types, flora

and fauna species, as well as for human activities based on recently mapping and monitoring projects within the Natura 2000 network. Land cover maps and the Natura 2000 datasets, are available at the national level and have already been validated and used for some first ES assessments. Moreover, data for protected or endangered species are available through the Red-list catalogues of Greece (Phitos et al. 1995, Phitos et al. 2009, Legakis and Maragou 2009) and other publications such as Tan and Iatrou (2001) and Barbieri et al. (2015).

The marine environment and the country's seas and coasts have been a source of fascination and study since antiquity (Voultsiadou and Vafidis 2007); however there is a lack of spatial information on the distribution of marine biodiversity, human activities and their impacts. In the framework of the research projects MESMA (http://www.mesma.org/) and MARISCA (http://www.marisca.eu) there were efforts to integrate and harmonize information from various and scattered sources and map priority and vulnerable ecological components, human activities and management measures in the Greek Ionian (Issaris et al. 2012) and the Aegean sea respectively (Katsanevakis et al. 2017). MARISCA provided distribution maps in the Aegean Sea of 67 species and habitats and 19 current or planned human activities, including fisheries, shipping, tourism, aquaculture, underwater cables and pipelines, hydrocarbon exploitation and offshore wind parks. These studies, despite the data gaps, form a valuable baseline for marine ES assessments and adaptive marine management. At the same time, fisheries constitute the best-studied activity in the Greek seas, with a wealth of information about their state and total production (Papaconstantinou et al. 2007), their impact (e.g. Smith et al. 2000) and the distribution of their activities and of fishing grounds (Maina et al. 2016).

Detailed surface imagery data (orthophoto maps) is also available online for the years 1945 to 2007 (NCMA 2017).

3.2. Socio-economic data availability

Data on the socio-economic aspects of ES are significantly fewer, as they were rarely collected systematically and within an ES framework. Thus, data would have to be repurposed from other sectors, e.g. the agricultural or tourism sector statistics. The official source of socio-economic data for Greece is the Hellenic Statistical Authority (http://www.statistics.gr), which collects, collates and offers data on a variety of topics. Notably, a significant amount of this data is only available at the national level, making sub-national geographical assessment difficult. The most thorough (in time and space resolution) and valuable data available from the Statistical Authority refer to agricultural production statistics (Annual Agricultural Statistical Survey), related to provisional ES. They are available in yearly estimates (2001-2014) and are geographically broken down to 74 prefectures. In addition to agriculture, the next most detailed data are for tourism, for which the Authority provides a wealth of data related to arrivals and hotel stays at the municipality scale (2003-2015). More detailed data on tourist visits to national parks can be found within each park's website. Recent advances in information technology such as the Big Data revolution (e.g. open access databases) will perhaps allow ES researchers

to be able to collect socio-economic data faster and at lower costs than traditional surveys, and considering the dearth of socio-economic data readily available, Greece would significantly benefit from such an approach. Spatially referenced detailed data, such as energy demand for heating, green energy infrastructure, major dams, wildlife refuges, hunting areas etc., is also available through the geodata.gov.gr and the rae.gr portals.

4. The Hellenic Ecosystem Services Partnership (HESP)

4.1. Scope and goals

The establishment of the Hellenic Ecosystem Services Partnership aims to build a strong network of researchers and decision-makers that will be able to provide robust and valid assessments of ES at the National level. Such assessments will be based on all the knowledge described above, follow the EU standards, while taking into account the national specificities. To achieve that, a group of national experts was established aiming to:

i. Produce maps of ES at the national level, focusing also on target case studies and ecosystem types. The group will adapt existing ES mapping methodologies to the country's specificities.
ii. Create a strong network of research, practice and policy that will be able to have societal impact.
iii. Raise national awareness on the ecological, socio-cultural and economic values of ecosystems and ES in order to promote their sustainable use.

Maps of ES at the national level

There are different levels of complexity in the ES mapping approaches, from simple land-cover based approaches (Burkhard et al. 2012), indicator-based mapping (Egoh et al. 2012) to complex model-based approaches (Villa et al. 2014). Each of them has its pros and cons and the choice a researcher or practitioner will make depends on many factors, from available skills, resources, to the end-use of the map, but also the focal ES (Willemen et al. 2015). In most cases for national ES assessments, the mapping methods chosen vary across the different ES, mostly due to knowledge and data availability (Albert et al. 2016, Jacobs et al. 2015).

In that spirit, the HESP group of experts will pay special attention to mapping and quantifying the ES that are critical at the national level, after consultation with national level stakeholders. Assessments will take place both at national level, but also for selected case studies, targeting specific regions of special importance for the country (e.g. Natura 2000 regions) or biomes of special interest (e.g. mountain ranges, the coastal zone). All mapping approaches will follow the EU MAES and global (Crossman et al. 2013) standards to the extent possible, while adapting them to the national level and needs.

A strong network of research and practice that will be able to have societal impact

The implementation of the ES concept into policy and practice is not an easy task, not only for Greece, but globally (Barnaud and Antona 2014, Martinez-Harms et al. 2015). It requires an integrated and interdisciplinary approach for a successful result. This in turn means that data and knowledge have to be provided by several different scientific disciplines and combined into an applicable and effective "tool" for issues of local or broader scale. Moreover, these "tools" should be constructed in such a way that local administration, stakeholders, policy makers etc. will be able to understand, take into consideration, apply and also cope with tradeoffs.

To handle efficiently all this complexity and at the same time meet international requirements and national needs, while having a societal impact, a strong network of research and practice is required. As ES derive from ecosystems a deep knowledge on the latter is required. Therefore, scientists and academics from the field of ecology make the core of the HESP network. In the HESP core there is sufficient expertise to cover basic thematic aspects, such as mapping and modeling for most of the major biomes of Greece, such as marine, natural terrestrial ecosystems, agroecosystems etc.

At the same time, this expertise is suitable to be in line with and cooperate at the international level with other thematic, biome and regional groups of the ES partnership (ESP). With increased national and international level participation, the rate of knowledge and information-sharing will increase. On a second stage, the network will be further enriched with disciplines related to the economic and social valuation of ES. This is an essential step for enhancing the pragmatic dimension of the entire concept.

To achieve societal impact, but also to acquire the required resources, a further aim of the network is to reach out to stakeholders, policymakers, and the general public. The concept is not only to inform them or to make them passive observers, but to trigger their active participation. One step towards this direction is the organization of focus group discussions, participatory mapping workshops, and networking events in different parts of Greece. The aim of those is to: i) familiarize them with the ES concept, associated tools and methods; ii) communicate the necessity of applying MAES in Greece to promote sustainable development and growth; and iii) expand the HESP network to the various socio-economic and scientific groups which are related to the elaboration of the ES in Greece. Such activities are essential in order to incorporate the views, experience, needs and ideas of stakeholders and decision-makers, who will provide input on the national and local level needs and outline beforehand potential bottlenecks. Cooperation with other networks, institutions and organizations related to the natural environment and to biodiversity issues is also among the objectives of the network.

Raise awareness at national level on the value of ecological, socio-cultural and economic values of ecosystems and ES

Although the ES concept is explored in the country for many years now, the overall level of awareness on the role of ecosystems as sources that provide benefits to society is not

acknowledged as such. ES are missing from national level policies and from educational curricula. HESP aims to change this, by increasing literacy and raising awareness to three major groups of citizens: i) the young generation; ii) the general public; iii) the end-users.

An objective of HESP is to incorporate the ES concept in the Greek educational system. To achieve this, HESP will design ES training material and educational curricula to be included in high-school classes. The partnership will also promote the inclusion of ES courses in Universities and Technical Institutes, adapted always to each Department's/ Faculty's needs. HESP will consult the competent Ministries and Institutions to compile and produce the appropriate educational material and help them transform and update relevant courses to include and promote knowledge on ES.

HESP recognizes the additional benefits of incorporating standardized citizen science practices in the fields of ecosystem and biodiversity (Hochachka et al. 2012, Kobori et al. 2015) increasing, thus, the HESP's visibility in society. Through a set of campaigns, dissemination of activities in the press, but also in the country's media the research activities will be communicated giving emphasis to improving citizen awareness. Citizens will become aware of the impact that their everyday actions have on ecosystems and also of the reciprocal effects their actions have on the benefits they receive from ecosystems. To achieve this, the HESP will collaborate with experts on science-communication to the public and designers of awareness campaigns. After all, societal engagement is the most significant element for policies and laws to be successful.

4.2. Partnership organization

The HESP group is strongly linked to other thematic, regional and biome groups working on international ES assessments. In particular, HESP members are strongly collaborating with the Mapping Working Group of the Ecosystem Services Partnership (ESP), the Mediterranean Working Group, but also the Marine Working Group. Through these links and interactions with these groups, HESP will benefit from building the Greek national level assessments on existing knowledge, while validating the broader scale approaches followed by these groups at the National level.

Mapping and assessing ES at national, regional and local scale is a demanding and interdisciplinary task and thus HESP will propose and create thematic ES groups to work on ES at different scientific fields (e.g. ecology, socio-economics etc.), as well as at different scales. Based on MAES level 1 and level 2 ecosystem type categories and on the diversity of the Greek environment, the proposed thematic groups are: i) Terrestrial, natural ecosystems; ii) Agro-ecosystems; iii) Marine ecosystems; and iii) Urban ecosystems. These groups can be divided to specialized sub-groups when conducting large (fine) scale assessments (e.g. fresh water group, woodland and forest group). Each group will be responsible to produce a national set of indicators for its thematic category and test them in at least one relevant case-study. The resulting outcomes from all thematic groups will be elaborated and analyzed to prepare a technical guide of common

practices and methodologies based on the special characteristics of the Greek environment (e.g. national set of indicators, minimum mapping units).

5. Drafting the conceptual framework for ES assessments

To frame the national ES assessment, the managing group of HESP prepared an adapted conceptual framework fitting to the purpose of the national ES assessment. This takes into account many of the already developed frameworks. One of the most commonly used, but also fairly questioned, is the ES Cascade framework (Haines-Young and Potschin 2010). For all the different national level assessments, adapted versions of existing ES frameworks have been developed. For instance, Jacobs et al. (2015) developed a different approach for the Flanders Regional Assessment. At the same time IPBES, has also developed a more explicit framework targeting mostly the links of ecosystem services with human well-being (Díaz et al. 2015).

For the Greek assessment, we took into account the specificities of the country, but also the available information within the given timeframe, and thus came up with a first approach of the conceptual framework. This framework is designed based on the best available information currently at hand. It is mainly based on recent ecological data derived from the monitoring and habitat mapping projects in the Natura 2000 network sites of Greece, where detailed spatial data is also available. It also utilizes all other available spatially referenced data (especially for the areas outside Natura 2000 sites) such as the Corine Land Cover and LUCAS datasets, digital elevation models (DEM), recent satellite imagery and orthophoto maps etc., alongside with field survey data, depending on the scale of the analysis (Fig. 1). The proposed framework, although prone to change, will serve as a compass that will guide the production of the first set of national ecosystem type and ecosystem type condition maps for ES mapping and assessment. By using these maps, the ES thematic groups will conduct ES indicator assessments and mapping, resulting in the national set of indicators for each thematic field and the relevant ES maps for Greece.

ES assessment at different scales

One of the most important parts of HESP working framework is to assess ES at different scales within the Greek territory (i.e. national, regional and local), aiming to create, in the most detailed way, the national ES index; an index of all ES supply, flow and demand, throughout Greek territory. It is considered as crucial for the creation of a reliable index to conduct large (national) scale assessments for various services, as well as assessments at the finest possible way (i.e. local scale or specific ES indicators' assessments); the more data from fine scale assessments, the more detailed data will be available for the upper scale assessments (e.g. many local scale assessments within a region support better the regional assessments as base-line or reference data) and by this the assessment detail is accordingly increasing at each higher scale.

To fulfill this conceptual structure: i) the HESP scientific committee will be responsible for national scale assessments and reporting, ii) regional thematic group associates will be responsible for assessments in their region, while iii) experts at specific fields will contribute in and conduct local level and ES indicators assessments (Fig. 2). These assessments will be further used to inform the EU level MAES assessments, and the national level assessment for IPBES.

6. Drafting the National agenda

For now, the most important role of HESP is to prepare the road map – a National Agenda – for the implementation of ES assessments in Greece, which will then feed into MAES and IPBES. A first drafting of this agenda, was presented in the International Scientific Conference on ecosystem services, held in Sofia, 2017. The milestones of the National Agenda read as follows:

- The short-term objectives that will be achieved by the end of 2017:
    - Establishment of thematic research groups (based on expertise, i.e. for terrestrial, marine, urban etc.)
    - Establishment of commonly agreed methodology, based on the special characteristics of the Greek environment (national set of indicators, minimum mapping units etc.)
    - Stakeholder involvement – Dissemination actions
    - Systematic literature review identifying and organizing existing ES knowledge in Greece, in a shared database
    - Identification of provided ES in Greece, with national and EU importance and use them as an asset and strong argument in funding claiming
    - Identification of ES as the core of the National Capital.
- The mid-term objectives to be achieved from 2018-2020:
    - Creation of a national geodatabase for all available ES data
    - Development and testing of a national set of indicators (contribution to IPBES)
    - Production of ES maps for all the Greek territory
    - Focus on specific local scale ES studies at the protected areas level
    - Identification of ES hot-spot areas
    - National ES accounting
    - Incorporating /mainstreaming ES into cross sectoral policy and regulatory frameworks ES-based management plans.

The HESP Action Plan to 2020 (Fig. 3) can set the basic steps needed to achieve decision making based on ES enhancement and maintenance. These steps are in temporal order: i) Biophysical assessment and mapping; ii) Social assessment and mapping; iii) Economic valuation; and iv) Development and assessment of future scenarios.

7. Summarizing note

HESP is established to promote and assist all types of ES assessments in Greece aiming to fulfil national biodiversity strategy's relevant goals and provide detailed and reliable data to EU agencies. For now, HESP's primary and urgent objective is to implement its Action Plan, by completing the bio-physical assessments (2017-2018) and remain consistent throughout the process, until 2020, when policy-support outcomes should be available to support decision making. It is up to the board and its members to create and maintain an exemplary network of scientific cooperation, potentially advisory to the policy makers, with a positive impact on society, through the compilation of studies on sustainable national natural capital exploitation and protection.

Conflicts of interest

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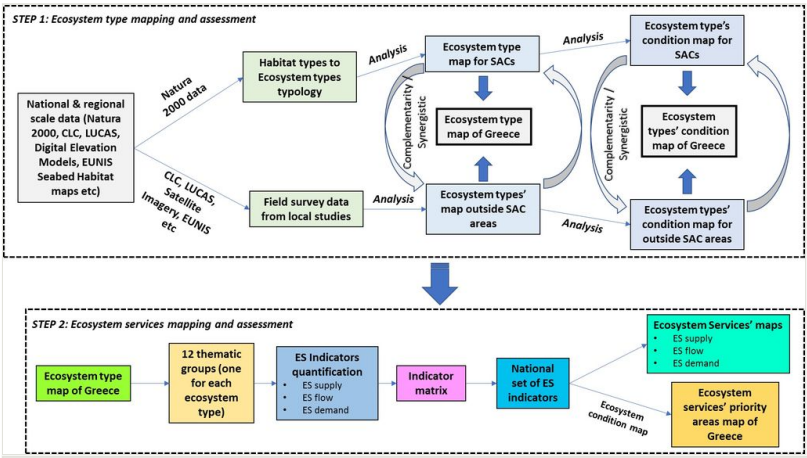

Figure 1.

A first approach on the conceptual framework for mapping and assessment of Ecosystem Services in Greece.

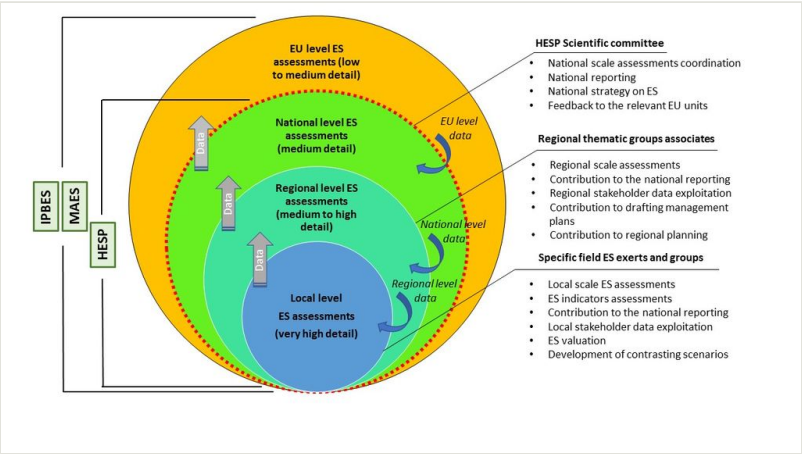

Figure 2.

HESP conceptual working framework for ES assessments at different scales.

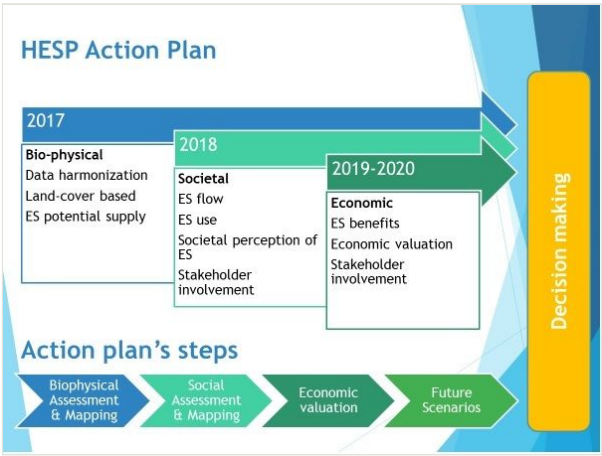

Figure 3.

The HESP Action Plan to 2020.

Table 1.

Brief overview of examples from scientific literature that address several aspects of ecosystem services in Greece. The purpose of this table is illustrative and is not exhaustive.

Reference	Year	Ecosystem type	ES assessed	ES type	"ES" term referred in text	Method	Location
Vlami et al. (2017)	2017	All	Cultural	Stock	Yes	Matrix model	Greece, Natura 2000 sites (SACs & SPAs)
Garantonakis et al. (2016)	2016	Cultivations	Regulation & Maintenance (Pollination)	Stock	Yes	Pollination efficiency for crop production	Western Crete
Chatzizacharia et al. (2016)	2016	Grasslands	Provisioning (Energy demand)	Benefit	No	Scenario assessment	Greece
Santamouris et al. (2015)	2015	Urban	Regulation & Maintenance	Benefit	No	Climate change models	Athens city
Voloudakis et al. (2015)	2015	Cultivations	Provisioning (Cotton yield productivity)	Stock	No	Climate change scenarios	Greece
Stara et al. (2014)	2014	Forest	Cultural	Benefit	Yes	Non-monetary valuation; surveys	NW Greece
Kontogianni et al. (2014)	2014	Coastal	Regulation & Maintenance	Benefit	Yes	Vulnerability assessment	Greece
Karali et al. (2014)	2014	Forest	Regulation & Maintenance	Stock	No	Scenario assessment	Greece
Grammatikopoulou and Olsen (2013)	2013	Wetland	All	Benefit	Yes	Contingent Valuation	Gialova & Sfaktiria Island
Koutroulis et al. (2013)	2013	Water resources	Provisioning (Water)	Stock	No	Scenario assessment (GCMs)	Crete
Salomidi et al. (2012)	2012	Marine	All	Stock	Yes	Biophysical analysis	Greece
Stithou and Scarpa (2012)	2012	Marine	Regulation & Maintenance (Biodiversity)	Benefit	Yes	Contingent valuation	Zakynthos
Kontogianni et al. (2012)	2012	Marine	Regulation & Maintenance (Existence value of charismatic species)	Stock	Yes	Contingent valuation	Lesvos
Jones et al. (2011)	2011	Coastal	Regulation & Maintenance	Benefit	No	Willingness to pay	Rethymno

Oikonomou et al. (2011)	2011	Coastal	All	Stock	Yes	Multi-criteria analysis	Kalloni Gulf, Lesvos
Tzanopoulos et al. (2011)	2011	Cultivations	Provisioning (Agricultural)	Flow	No	Scenario assessment	Greece
Tscheulin et al. (2011)	2011	Cultivations	Regulation & Maintenance (Pollination)	Stock	Yes	Landscape analysis	Lesvos
Petanidou et al. (2008b)	2008	Shrubs	Regulation & Maintenance (Pollination)	Stock	No	Network analysis	Athens
Jones et al. (2008)	2008	Coastal	Regulation & Maintenance (Coastal water quality)	Benefit	Yes	Contingent valuation	Lesvos
Makrodimos et al. (2008)	2008	Grasslands, Sparserly vegetated land	Regulation & Maintenance (Pollination)	Flow	No	Statistical analysis	Mount Olympos
Papadimitriou and Gibson (2008)	2008	Mountainous ecosystems	Cultural (Recreation and mountain sport tourism)	Benefit	No	Surveys	Epirus
Mente et al. (2007)	2007	Marine	Provisioning	Benefit	No	Socio-economic analysis	South Evoikos gulf
Grunewald et al. (2007)	2007	River	Provisioning (Water production, agricultural irrigation)	Flow	No	Biophysical assessment	North Greece
Togridou et al. (2006)	2006	Marine	Regulation & Maintenance (Biodiversity)	Benefit	No	Willingness to pay	Zakynthos
Skapetas et al. (2004)	2004	Grasslands	Provisioning (Grazing & herbage production)	Flow	No	Biophysical assessment	West Macedonia
Lekakis (2000)	2000	All	Regulation & Maintenance, Provisioning	N/A	No	Kuznets curve hypothesis	Greece
Genitsariotis et al. (2000)	2000	Cultivations	Provisioning (Energy)	Flow	No	Biophysical assessment	Chalkidiki
Zanias (1998)	1998	Cultivations	Provisioning (Agricultural productivity)	Benefit	No	Valuation	Greece
Zervas (1998)	1998	Grasslands, Shrubs	Provisioning (Livestock)	Flow	No	Biophysical assessment	Greece
Gerakis and Kalburtji (1998)	1998	Wetland	All	Benefit	No	Ranking	All Ramsar siters

Vokou et al. (1993a)	1993	Mountainous ecosystems	All	Benefit	No	Ethnobotanical study	NW Greece