

Prioritization of ecosystem services related to the natural heritage of Bulgaria

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ABSTRACT

Natural heritage (NH) is an important element of the natural capital of each country, and as such, represents key assets that deliver various benefits to the citizens. The rich and diverse NH of Bulgaria is a prerequisite for the development of various activities such as recreation and tourism, but these activities have also negative impact on some of the NH's elements. The concept of ecosystem services (ES) has the potential for bridging the gap between the conservation and exploitation needs. In this paper, we propose an approach to prioritizing the ES provided by the natural heritage of Bulgaria for the needs of recreation and tourism. The approach is designed for the mapping of the NH but it can also support the overall process of mapping and assessment of ES. It is based on application of ES prioritization matrix (ESPM) and a five-step algorithm designed to differentiate ES into priority levels according to their significance to recreation and tourism. Through the application of the proposed approach we were able to sort out the ES into three groups (high, medium and low priority) according to their importance to recreation and tourism. The first group contains obligatory ES for each mapping and assessment activity from national to local level. The second group contains optional ES recommended for studies at regional level, while the services can be selected according to the specifics of the study. The low priority ES are recommended for local level studies in cases where the assessment requires high details and accuracy. The mapping of high priority ES at national level shows that the products of the approach can be easily adapted for various studies for assessment of NH and sustainable tourism practices using the conventional mapping methods.

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1. Introduction

Natural heritage (NH) is an important element of the natural capital of each country, and as such, represents key assets that deliver various benefits to the citizens. There are several types of economic benefits which the natural and cultural heritage bring, such as the generation of labor income for individuals, companies, and/or governments, the number of jobs created or the economic output or values added to the economy (Gisselman *et al.* 2017). The benefits from the cultural heritage have been studied in many publications (Herdis *et al.* 2017), but the NH is still far less studied. NH includes natural features consisting of physical formations, geological features and physiographical formations, natural sites, or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation, or natural beauty (UNESCO 1972). NH is a part of nature that has retained its social significance over time and brings material and/or spiritual benefits of extremely high value to the previous and current generations. The rich and diverse NH of Bulgaria is a prerequisite for the development of various activities with significant potential for economic and social benefit. The outstanding universal value at national level can be represented as



“natural significance”, which refers to the importance of ecosystems, biodiversity and geodiversity for their existence value, as well as their scientific, social, aesthetic and life-support value (Harrison and O'Donnel, 2010). The analysis of the inheritance value of nature could be done using the ecosystem approach, which has the potential to contribute to establishing the sustainability of human-nature interactions and the benefits generated through these interactions. Ecosystems incorporate biotic and abiotic elements (i.e. biodiversity and geodiversity), and can be considered as the spatial units which represent the NH of a particular area in terms of their value to people. On the other hand, the economic activities related to the generation of benefits from the NH may cause negative impacts on ecosystems through pollution, intensified erosion, harm to wildlife or habitats, biodiversity loss, etc. Therefore, the NH sites are protected at both national and international level by different conservation regimes. The contradicting interests of economic activities and conservation purposes are sources of conflicts between different parties, especially at local level. The concept of ecosystem services (ES) has the potential for bridging the gap between conservation and exploitation needs, by identification, assessment and mapping of the various benefits provided by the NH, and by revealing the importance of NH sites' good condition to human well-being. The methodological framework for mapping and assessment of ecosystems and their service (MAES) provides operational guidance at European level (Maes et al., 2013), which has been further developed at national level in Bulgaria (Bratanova-Doncheva et al., 2017)

Every ecosystem assessment has to be relevant to a certain theme, and to address a broad range of questions pertaining to decision-making processes that occur at different levels of decision-making, and across different actors of the society (Burkhard et al., 2018). Recreation and tourism are among the economic activities which are strongly dependent on the NH, having a certain impact on the ecosystems' condition and the quality of the services they provide. The sustainable use of the ES provided by the NH for those activities, is one of the main challenges of nature protection management and the tourism sector in Bulgaria. However, there is a great variety of services provided by the ecosystems, and it is necessary to identify those provided by the NH. Furthermore, it is necessary to define the relation of all kinds of services to recreation and tourism activities. Therefore, we need an approach to the identification and systematization of ES provided by the NH in Bulgaria which are related to recreation and tourism. Prioritization of ES is an appropriate approach toward these objectives, and this is the main research problem of this study.

The prioritization of ES provided by the NH aims to identify the ES and range them according to their significance for recreation and tourism. The great variety of ES are systematized into different categories of classification systems such as those of Millennium Assessment (MA, 2005), TEEB project (Kumar, 2010), Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2013; 2018) and Final Ecosystem Goods and Services Classification System (FECS-CS) (Landers and Nahlik, 2013). CICES classification is accepted as a basis for the mapping and assessment of ecosystems and their services by the MAES working group. The ES in CICES are systematized into a five-level hierarchical structure as each level downward is progressively more detailed and specific. The first fully operational version of CICES (V4.3) was published in 2013, while the subsequent experience led to the revision of its structure, which resulted in a new version (V5.1), released in 2018 (Haines-Young and Potschin, 2018). The prioritization of

ecosystem services is an important task, but publications on the topic are limited. Prioritization as an approach is mainly applied in the context of conservation objectives, but there are also publications directly aimed at highlighting ecosystem services in support of ecosystem-based management (Werner et al. 2014; Hua and Chen 2019; Santarém et al. 2021). Landsberg et al. (2013) provide a practical six-step method for identifying and managing potential impacts and dependencies on ecosystems and ecosystem services, which is designed to integrate ES into the project impact assessment. The first two steps are directly related to the prioritization. Those are: 1) identification of relevant ecosystem services; 2) prioritization of relevant ecosystem services. Werner et al. (2014) developed a prioritization matrix to facilitate the prioritization of ES on the basis of perceived societal and financial value, as well as level of stress on coastal ecosystems. The matrix provides a simple and visually effective means of identification of the ES with the highest priority for monitoring and management purposes. Kulczyk et al. (2014) applied the Analytic Hierarchy Process to identify which of CICES categories are supposed to be the most important for tourism and recreation. However, prioritization of the ecosystem services provided by the NH has not been developed so far. This is the main challenge of this study and overcoming it is crucial for the development of a methodology to promote the access of the Bulgarian natural heritage to the European Digital Single Market of Knowledge and Information Services, which is a part of a broader research titled “Heritage BG Centre of Excellence (Nedkov et al., 2021; Nikolova et al., 2021; Semerdzhieva and Borisova, 2021; Silvestriev et al., 2021).

The main objective of this paper is to present an approach to prioritizing the ecosystem services provided by the natural heritage of Bulgaria, for the needs of recreation and tourism. More specifically we aim at: i) identifying the ES provided by the NH in Bulgaria; ii) prioritizing the ES provided by the NH in relation to recreation and tourism; iii) mapping the NH potential of ES at national level. The results are addressed simultaneously to all parties involved in the process of sustainable management of ecosystem services supporting the practice of tourism and recreation.

2. Materials and methods

2.1. General approach

The prioritization of ES is a process of selection and differentiation of services into groups of importance, based on particular criteria that match the conservation needs and the needs of particular businesses to achieve sustainable tourism. An ES prioritization matrix (ESPM) is applied to facilitate this process by providing a simple and visually effective means of identification of the ES with the highest priority (Werner et al., 2014). The prioritization is usually applied through a step-by-step approach which starts with the identification of ES, followed by assessment and selection of the priority services (Landsberg et al., 2013). In this study, we have developed a prioritization approach that integrates an ESPM into a five-step algorithm designed to facilitate the mapping and assessment of ES provided by the NH (Fig. 1). We have used CICES (V5.1) classification (Haines Young and Potchin, 2018) as a source for ES selection, the ES matrix method (Burkhard et al., 2009; 2012; 2014) – to develop the assessment scale of the prioritization matrix, a review of studies on natural recreational resources and their assessment (Popova, 1993; Evrev, 1999; Nedyalkov and Bekyarova, 2000; Mitova, 2020; Priskin, 2001; Cetin & Sevik, 2016; Cocklin et al., 1990), and a review of studies on cultural ES (Daily, 1999; MEA,

¹ <https://eufordigital.eu/discover-eu/eu-digital-single-market/>

² <http://www.nasledstvo.bg/>

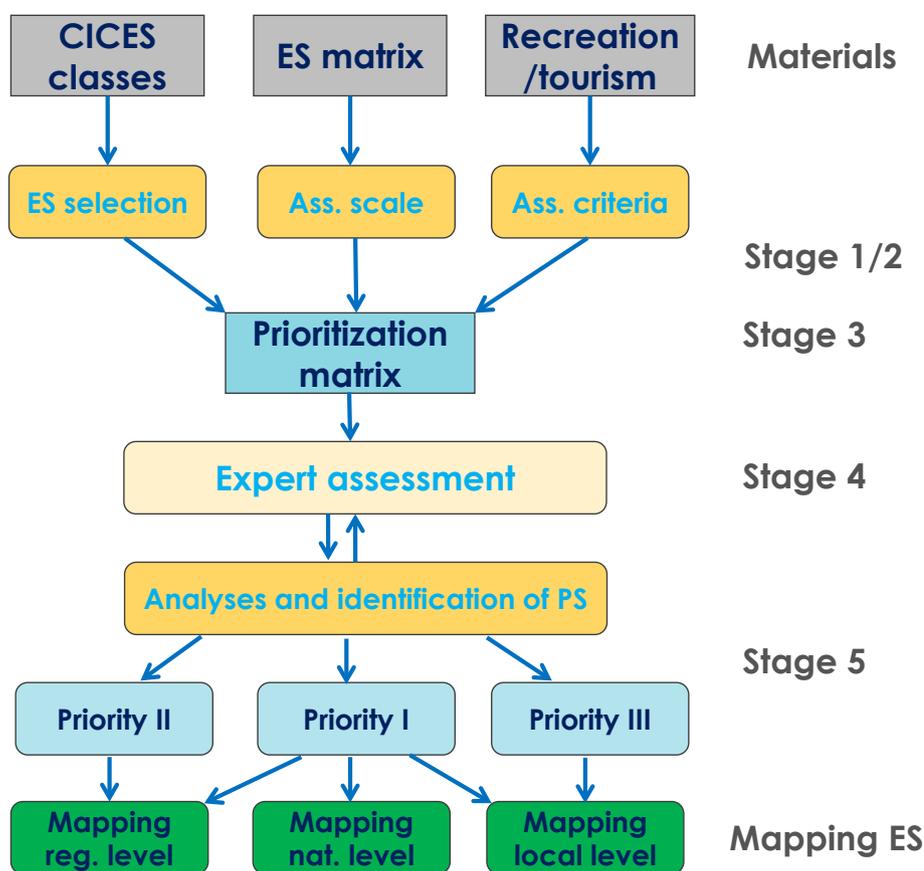


Figure 1. Conceptual scheme of the prioritization approach

2005, de Groot et al., 2010), so as to develop assessment criteria for relevance to recreation and tourism activities. All these elements are integrated into the ESPM, and at the next stage the selected ES are assessed by experts. The assessment results are analyzed and some of the scores are reevaluated in case of high deviation of the expert scores. The differentiation of ES into priority levels is applied in order to: i) arrange the ES according to their significance to recreation and tourism and; ii) apply mapping and assessment of ES at multiple scales (national, regional, local).

2.2 Main stages

2.2.1. Selection of ecosystem services

CICES (V5.1) is organized in a five-level taxonomic system including levels such as section, division, group, class, and class type. At the first level, six sections correspond to the three main groups of ES (provisioning, regulating and cultural), each of them divided into biotic and abiotic sections (Suppl. material 1). The sections are further divided into the more detailed divisions at the next levels, while the total number of individual services at class level is 96. At class type level, services are not precisely specified. Therefore, for the purposes of this study we chose the services at class level. The main criteria for the selection at this stage were the relevance to recreation and tourism, and applicability for mapping and assessment purposes. The latter is based on the experience from the selection of ecosystem services for the MAES activities in Bulgaria, where some classes have been merged for practical purposes (Nedkov et al., 2019). Each individual service at class level was reviewed for relevance to recreation and tourism, and those with no relevance were removed from the list. Some services were merged into more general classes.

For instance, cultivated terrestrial plants (including fungi, algae) grown for nutritional purposes (CICES code 1.1.1.1) and fibres and other materials from cultivated plants, fungi, algae and bacteria for direct use or processing (1.1.1.2) were merged, as it is impossible to distinguish them based on the existing quantitative data sources. Thus, the number of ES was reduced to 48 (Suppl. material 1).

2.2.2. Defining criteria of prioritization

“Recreation ecosystem services” are not defined as a separate category in the existing ES classification. Instead, they are presented as an aspect of the cultural services, while in some cases ecotourism and recreation are defined as individual ES (Mitova, 2020). The prioritization of ES for the needs of recreation and tourism necessitates defining criteria to assess the relevance of the ES to these activities. Mitova (2020) proposes seven recreational services which present the complex of recreational benefits provided by the ecosystems to people, in relation to their needs and motivation for visits, as well as for development of differentiated recreation-tourism products. In this study, we used those services as criteria for prioritization of the CICES classes, selected at the previous stage. They are formulated as follows:

Function-technological – they provide favorable conditions for certain outdoor recreational activities, tourism, sports and entertainment, from the point of view of the technology of carrying out the given activity. For instance, ski tourism needs stable snow cover with a thickness of not less than 20 cm, northern exposure, steep slopes, treeless areas, etc.;

Physiological (health) – they have favorable effect on human health, stimulate a healthy lifestyle, ensure comfort, safety, healing properties, clean environment;

Aesthetic – they bring aesthetic pleasure and have a beneficial effect on the psychological state of people;

Economic-technological – they provide cost-effective opportunities for economic (recreational and tourism) development;

Knowledge – they meet the needs of knowledge and its transmission to future generations (science, education, curiosity), and have a positive cognitive effect on people;

Spiritual – they stimulate spiritual development and creativity, provide connection with the tangible and intangible cultural heritage (religion, beliefs, art, traditions, folklore, crafts, cuisine, etc.), and are related to the ethno- and civilizational identity, and the local culture;

Ethic – they stimulate the understanding of the needs for nature protection, and encourage responsible behavior.

2.2.3. Development of prioritization matrix

The prioritization matrix is a research tool that has been applied in various fields ranging from quality functions deployment to environmental assessment and decision making (Wang et al., 1998, Zhou and Schoenung, 2008. Tovar-Perila et al., 2018). Such a matrix can facilitate a simple methodological process of using the ES approach in order to identify and prioritize different activities such as management actions (Werner et al., 2014) or impact assessment (Landsberg et al., 2013). In our case, the matrix has been designed to facilitate the prioritization of ES provided by the NH for the needs of recreation and tourism. The key elements of the ESPM are the ES selected at the first stage (arranged in the matrix's rows), and the criteria for relation to recreation and tourism, defined at the second stage, which are presented as columns (Suppl. material 2). For practical reasons, the services are given in numbers, corresponding to the 48 classes (Suppl. material 1). The ES relevance to recreation and tourism criteria were assessed on a relative scale ranging from 0 to 5 (based on Burkhard et al., 2009). A 0-value indicates that there is no relevance between a particular service and the corresponding criteria in the matrix. The other values have the following meaning: 1 – very low relevance; 2 – low relevance; 3 – medium relevance; 4 – high relevance; 5 – very high relevance. Of course, the scores depend on each expert's assessment and knowledge on which criteria-service relations are supposed to be relevant in the first place.

2.2.4. Expert assessment

The expert assessment of ES is one of the most popular ES assessment techniques that is technically simple and quickly provides understandable and mappable ES data (Jacobs et al., 2015). Expert assessment is used when it is difficult or even impossible to collect all data needed for complex ES assessment based on other data sources such as direct measurements, modeling or monitoring (Burkhard et al., 2015). In this study the matrix described above was introduced to a group of 12 experts involved in the "Heritage BG" project. The experts' profile involves five researchers whose primary field is landscape ecology, three forestry experts, two tourism experts, one climatology expert and one expert in geoinformation science. All of them have certain experience in ES research, varying from advanced to intermediate and basic. Each of the experts also received guidance which included objectives of the prioritization, instructions, and assessment criteria (see 2.3.2). The main objective was formulated as determining the ES where the NH is related to a certain recreation or tourism activity.

2.2.5. Analysis and identification of priority services

The matrixes filled in by the experts were then collected in a single sheet, and the results were analyzed according to the objectives of the study. The analysis was organized in several steps, similar to the approach used by Stoll et al. (2015), which include: 1) statistical

processing of the primary results; 2) analysis of the experts' scores and the score deviations; 3) verification of the deviations; 4) revision of the results where a large deviation had been observed; 5) statistical analysis of the ES, based on their relation to recreation and tourism; 6) distribution of the services into groups of importance. At the first stage the experts' scores were statistically processed to define the minimum and maximum scores for each service and the difference between them, as well as the standard deviation of the scores. At the second stage the services with the highest deviations were selected and the scores of the experts were analyzed in order to define if some experts' scores deviate significantly from those of others. At the third stage the scores with such deviations were verified, while at the fourth stage some of them were revised. At the fifth stage the revised results were grouped according to the CICES sections, and statistics for each of them were calculated. At the sixth stage the services were divided into three groups of importance, based on the results from the previous stage. The first group contains high priority services which need to be included in all kinds of NH assessment at all levels (national, regional and local). The second group contains medium priority services which can be added to the assessment of specific recreation or tourism activities at regional level. The third group contains low priority services which can be added to the assessment of specific recreation or tourism activities at local level (see fig.1).

2.4. Mapping of natural heritage potential

Maps of ES are made for a broad set of purposes. The main map requirements are reliability, accuracy, resolution and clarity. The maps' importance varies according to the mapping purpose (Jacobs et al., 2017). In this study, the main purpose of the mapping is to test whether the priority services, defined by the proposed approach, can be used for mapping and assessment of the NH in Bulgaria. As there is still not enough data on the NH at regional and local level, the test was limited to national scale only. We used the ES matrix approach (Burkhard et al., 2009) which estimates the capacities to provide ecosystem services based on land use or land cover data, and starts with an expert assessment. The approach uses a relatively simple matrix where the ecosystem services are ordered in columns, while the geospatial units – in rows. In our case we used the MAES ecosystems subtypes derived from CORINE Land Cover data as geospatial units (Hristova and Stoycheva, 2021). We assume that each ecosystem subtype contains a particular range of NH objects (Nedkov et al., 2021, in this issue). The ecosystem's capacity to provide an ecosystem service is estimated at each intersection of ecosystem subtype and service. The scores for ecosystem services' capacity are added as attributes to the GIS layer of ecosystem subtypes. Thus, the GIS database could be used to generate supply maps of each ecosystem service or group of services. As there are 15 individual ecosystem services altogether, it is not appropriate to present all possible maps in this paper. Therefore, we decided to develop maps of the provisioning, regulating and cultural group of ES, as well as a general map of all ES.

3. Results

3.1. Assessment of the ecosystem services according to their significance for recreation and tourism

The analyses of the results from the ESPM expert scores exhibit particular deviations in the case of some services. Therefore, further calculations were performed in order to analyze these deviations. Standard deviation of the scores given by the experts was calculated for each ES. The results showed that the standard deviation of the average results per ES varied between 1.09 and 1.85 with an average of 1.48 (Fig.2). Furthermore, maximum and minimum scores for each

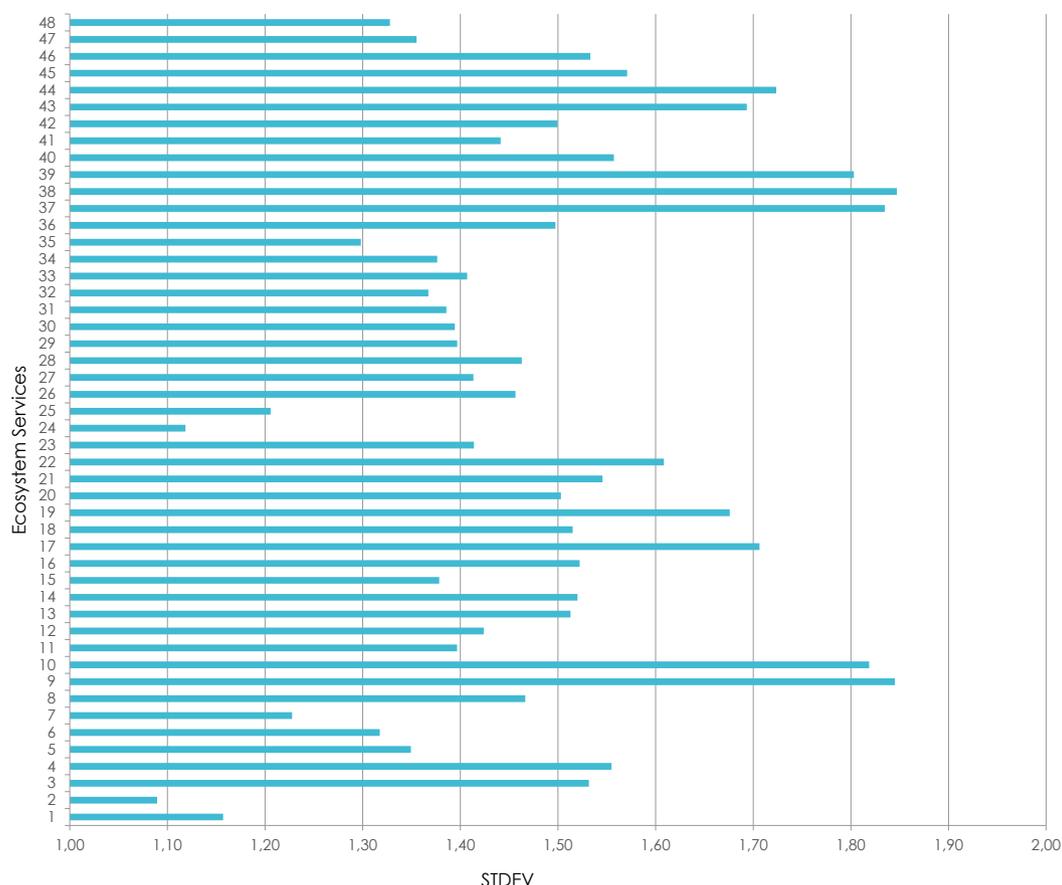


Figure 2. Standard deviation (STDEV) of the experts' scores by service (the numbers of the services correspond to the names given in Suppl. material 1).

service and the difference between them, were also calculated. That difference varied between 3.31 and 5.0, with an average of 4.21. The services where high standard deviation had been observed, usually also had a high min/max difference. The services whose scores exceeded 1.51 by standard deviation and 4.5 by min/max deviation (14 altogether) were verified by rechecking the interpretation of the criteria by the experts who gave such scores.

The average scores given by the experts per ES were calculated. They varied between 1.3 and 4.1 (an average of 3.0). The deviations of the experts' scores from this average value varied between 1.1 and -1.7 (Fig.3).

It was obvious that some experts had exaggerated the relevance of some services to recreation and tourism, while others had underestimated it. This time the verification considered the

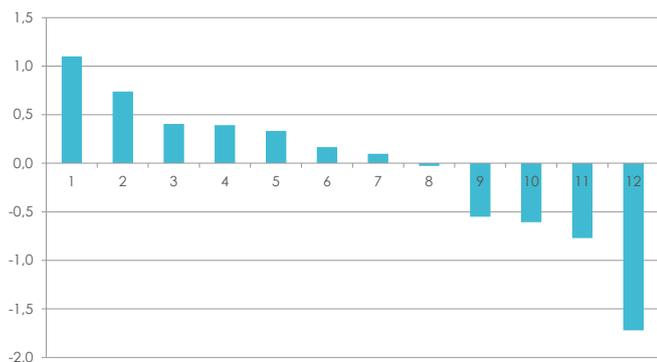


Figure 3. Deviation of the experts' scores

assessment criteria's interpretation of those experts who had given scores with higher deviations (exceeding 1 and -1). After a discussion on the assessment criteria, those experts were asked to reevaluate their scores and fill in the matrix again. The new results were collected in a separate sheet and all scores were recalculated so as to make adjusted results for all ES.

The services with the highest scores for relevance to recreation and tourism were Natural, abiotic characteristics of nature that enable spiritual, symbolic and other interactions (№47), with a score of 4.2, and Natural, abiotic characteristics or features of nature that have either an existence, option or bequest value (48), with a score of 4.1 (Table 1). After the adjustment, their scores raised to 4.6 and 4.3 respectively. But two other services gave higher scores, which made them almost equal to the previous. Those are Natural, abiotic characteristics of nature that enable intellectual interactions (46), with an adjusted score of 4.6 and Characteristics of living systems that are resonant in terms of culture or heritage (28), with an adjusted score of 4.5. The services with the lowest scores were Wild plants (terrestrial and aquatic, including fungi, algae) used as a source of energy (7), with a score of 1.4 (1.8 after the adjustment) and Wind protection (15), with a score of 2.2 (2.4). In general, the adjustment led to an increase of the average score of all ES from 3.0 to 3.3.

The aggregated scores per ES section had higher values for cultural (both biotic and abiotic) services (Table 2). The lowest score was calculated for the regulation abiotic services, while the regulation biotic services had a higher score than the provisioning biotic ES. Relatively high is also the score of the provisioning abiotic ES.

Table 1. Assessment scores of the ES (I – initial scores; A – adjusted scores after the verification).

Section	№	Score I	Score A	Section	№	Score I	Score A	
Provisioning (Biotic)	1	2.7	2.8	Cultural (Biotic)	25	4.0	4.4	
	2	2.7	2.8		26	3.2	3.4	
	3	2.3	2.6		27	3.4	3.7	
	4	2.4	2.8		28	4.0	4.5	
	5	2.6	2.9		29	3.9	4.3	
	6	3.2	3.4		30	3.8	4.1	
	7	1.4	1.8		31	4.0	4.3	
	8	2.8	2.7		32	4.0	4.2	
	9	2.3	2.7		33	3.7	3.6	
	10	2.3	2.7		34	4.0	4.2	
Regulation & Maintenance (Biotic)	11	2.6	3.1	Provisioning (Abiotic)	35	3.2	3.6	
	12	2.6	3.0		36	2.7	2.9	
	13	2.3	2.4		37	3.2	3.9	
	14	2.7	3		38	2.6	3.2	
	15	2.2	2.4		39	2.6	3.3	
	16	2.3	2.6		40	2.7	3.1	
	17	2.5	3.3		Regulation & Maintenance (Abiotic)	41	2.4	2.7
	18	3.4	3.8			42	2.4	2.6
	19	2.5	2.8			43	2.5	2.8
	20	2.6	2.9			44	2.3	2.6
21	2.4	2.7	Cultural (Abiotic)	45	3.8	4.4		
22	2.5	2.8		46	3.9	4.6		
23	2.7	3		47	4.2	4.6		
Cultural (Biotic)	24	3.9	4.1	48	4.1	4.3		

Table 2. Assessment scores per ES sections (I – initial scores; A – adjusted scores after the verification).

Section	Score I	Score A
Provisioning (Biotic)	2.46	2.72
Regulation & Maintenance (Biotic)	2.56	2.92
Cultural (Biotic)	3.79	4.08
Provisioning (Abiotic)	2.82	3.33
Regulation & Maintenance (Abiotic)	2.41	2.67
Cultural (Abiotic)	4.00	4.45

3.2. Priority ecosystem services in relation to recreation and tourism

The results of the ESPM were analyzed so as to distribute the ES into groups of importance according to their relevance to recreation and tourism. As the scores per section were different, the separation of ES was made section by section. The ES from each section were distributed into three groups: of high, medium, and low priority, according to their score compared to the average of the respective section. For instance, the ES in the high priority group from the cultural biotic section had scores between 4.2 and 4.4 (section average of 4.08), while the same ES group from the regulation abiotic section had scores between 2.7 and 2.8 (2.67). The average of the maximum scores given by experts was used as an additional indicator when the other scores were too close to make a clear distinction. Furthermore, some services in the high priority group were merged so as to facilitate the ES assessment at national level, where a lack of appropriate data had been identified. For practical reasons, to make the further assessment more fluent, the formulations of some services were simplified. Thus, 15 services

were defined as high priority services (Table 3). These services are obligatory for each mapping and assessment activity of the NH for the needs of recreation and tourism, and serve as reference services for mapping at national level. The second group (medium priority) also contains 15 services, which can be used as optional for mapping

at regional and local level. The choice of services depends on the specifics of the particular recreation or tourism activity, as well as on data availability. The group of low-priority services contains nine ES that can be used as optional at local level.

Table 3. Prioritization of the ecosystem services for mapping and assessment of NH in relation to recreation and tourism.

Priority	№	Services	CICES classes
High priority	I	Cultivated plants and animals used for nutrition	1.1.1.1; 1.1.2.1; 1.1.3.1; 1.1.4.1
	II	Wild plants used for nutrition	1.1.5.1
	III	Animals reared to provide energy	1.1.3.3
	IV	Surface water for drinking	4.2.1.1; 4.2.2.1
	V	Regulation of pollution and other harmful impacts	2.1.2.1; 2.1.2.2; 2.1.2.3; 5.1.2.1
	VI	Regulation of natural hazards	2.2.1.3; 5.2.1.1 5.2.1.2; 5.2.1.3
	VII	Maintaining populations and habitats	2.2.2.3
	VII	Local climate regulation	2.2.6.2
	VIX	Condition for recreation provided by biotic systems	3.1.1.1; 3.1.1.2
	X	Scientific and educational value	3.1.2.1; 3.1.2.2
	XI	Cultural heritage	3.1.2.3
	XII	Aesthetic experiences	3.1.2.4
	XIII	Symbolic and spiritual value provided by biotic systems	3.2.1.1; 3.2.1.2; 3.2.1.3
	XIV	Condition for recreation provided by abiotic systems	6.1.1.1
	XV	Symbolic and spiritual value provided by abiotic systems	6.1.2.1; 6.2.1.1
Medium priority	XVI	Fibres and other materials from plants	1.1.1.2; 1.1.5.2
	XVII	Fibres and other materials from animals	1.1.3.2; 1.1.4.2; 1.1.6.2
	XXVIII	Wild animals used for nutritional purposes	1.1.6.1
	XIX	Genetic materials from plants, algae or fungi	1.2.1.1; 1.2.1.2; 1.2.1.3
	XX	Genetic materials from animals	1.2.2.1; 1.2.2.2
	XXI	Mineral substances used for material purposes	4.3.1.2; 4.3.2.2
	XXII	Pest and disease control	2.2.3.1; 2.2.3.2
	XXIII	Regulation of the chemical condition of freshwaters	2.2.5.1
	XXIV	Regulation of chemical comp. of atm. and oceans	2.2.6.1
	XXV	Mediation of wastes or toxic substances by living processes	2.1.1.1; 2.1.1.2
	XXVI	Pollination and seed dispersal	2.2.2.1; 2.2.2.2
	XXVII	Mediation of waste by non-living processes	5.1.1.1; 5.1.1.2; 5.1.1.3
	XXVIII	Characteristics of living systems that have an existence value	3.2.2.1
	XXIX	Characteristics or features of living systems that have an existence value	3.2.2.2
	XXX	Natural, abiotic characteristics or features of nature that have either an existence, option or bequest value	6.2.2.1

Table 3. *Cont'd.*

Low priority	XXXI	Wild plants used as a source of energy	1.1.5.3
	XXXII	Surface water used as a material	4.2.1.2
	XXXIII	Ground water (and subsurface) used as a material	4.2.2.2
	XXXIV	Wind, solar, and geothermal energy	4.3.2.3 4.3.2.4 4.3.2.5
	XXXV	Control of erosion rates	2.2.1.1 2.2.1.2
	XXXVI	Wind protection	2.2.1.4
	XXXVII	Fire protection	2.2.1.5
	XXXVIII	Regulation of the chemical condition of salt waters	2.2.5.2
	XXXIX	Mediation of nuisances by abiotic structures	5.1.2.1

3.3. Mapping of the natural heritage potential to deliver ecosystem services at national level

The high priority ES defined at the previous stage were tested for mapping at national level using the express matrix assessment method. The scores in the matrix (Table 4) were given by experts

asked to estimate the potential of the NH of each ecosystem subtype to provide ES. The highest scores were given to forest ecosystems with broad-leaved forest subtype, which gained the maximum average score of 3.53. Their potential was very high as far as regulation services are concerned, while for the provisioning services it was medium to high. River and lake ecosystems also exhibit relatively high

Table 4. Assessment matrix of the high priority ES for mapping at national level (for numbers of ES see Table 3).

Ecosystem type	Ecosystem subtype	Mat.				Reg.	Cult.				Cult.					
		I	II	III	IV		V	VI	VII	VIII	XIX	X	XI	XII	XIII	XIV
1. Urban	J1. Residential high density	1	1	0	0	0	1	1	0	1	0	1	1	0	1	0
	J3. Residential low-density	3	2	4	0	1	2	3	2	2	2	3	2	2	1	0
	J5. Green urban areas	0	1	1	0	4	3	4	5	5	4	4	4	2	1	0
	J6. Industrial	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0
	J7. Transport	0	1	2	0	1	1	1	1	0	0	0	2	0	0	0
	J8. Minerals extraction sites	0	0	1	0	0	0	0	0	0	2	0	2	0	0	1
	J9. Dump sites	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Agricultural	I.1. Annual crops	5	1	1	1	1	1	2	1	2	1	4	3	3	1	0
	I.2. Perennial crops (orchards)	5	1	1	1	1	1	2	1	2	1	4	3	3	1	0
	I.3. Perennial crops (vegetables)	5	1	1	1	1	1	2	1	2	1	3	2	1	1	0
	I.4. Mixed agricultural areas	4	2	0	1	2	3	3	2	3	1	3	4	2	1	0
3. Grassland	E2. Wet grasslands	1	1	0	1	1	2	3	1	3	2	1	3	1	1	0
	E3. Seasonal wet grasslands	1	1	0	1	1	2	3	1	3	2	1	4	1	1	0
	E4. Subalpine grasslands	0	0	0	1	1	2	4	1	4	3	1	4	1	1	0
4. Heath. and Shrubs	F2. Subalpine shrubs	0	2	0	2	2	3	4	2	4	3	1	4	3	3	0
5. Forest	G1. Broad-leaved forests	0	4	0	3	5	5	5	5	5	5	5	5	5	1	0
	G2. Broad-leaved copice forests	0	3	0	3	4	4	4	4	4	4	4	5	3	1	0
	G3. Coniferous forests	0	3	0	3	5	5	5	5	5	5	5	5	5	1	0
	G4. Mixed forest	0	3	0	3	5	5	5	5	5	5	5	5	4	1	0
6. Sparsely vegetated land	B1. Coastal dunes	0	0	0	1	2	2	5	1	4	5	1	5	5	4	5
	H2. Screens	0	0	0	1	0	0	3	0	1	4	0	3	0	5	4
	H3. Continental rocks	0	0	0	1	0	0	3	0	1	4	3	5	2	5	5
7. Wetlands	D2. Swamps and transitional bogs	0	1	0	2	4	4	5	5	3	5	1	4	3	1	1
	D5. Reed and other swamp communities	0	1	0	2	4	4	5	5	3	5	1	4	3	1	1
8. Rivers and lakes	C2.3. Permanent water streams	0	4	0	5	5	0	4	1	5	5	5	5	2	5	5
	C1.1. Permanent lakes and water bodies	0	4	0	5	2	1	4	3	5	5	3	5	2	5	4
9. Marine	X2. Saline coastal lagoons	0	3	0	1	3	0	4	2	5	5	4	5	2	5	4

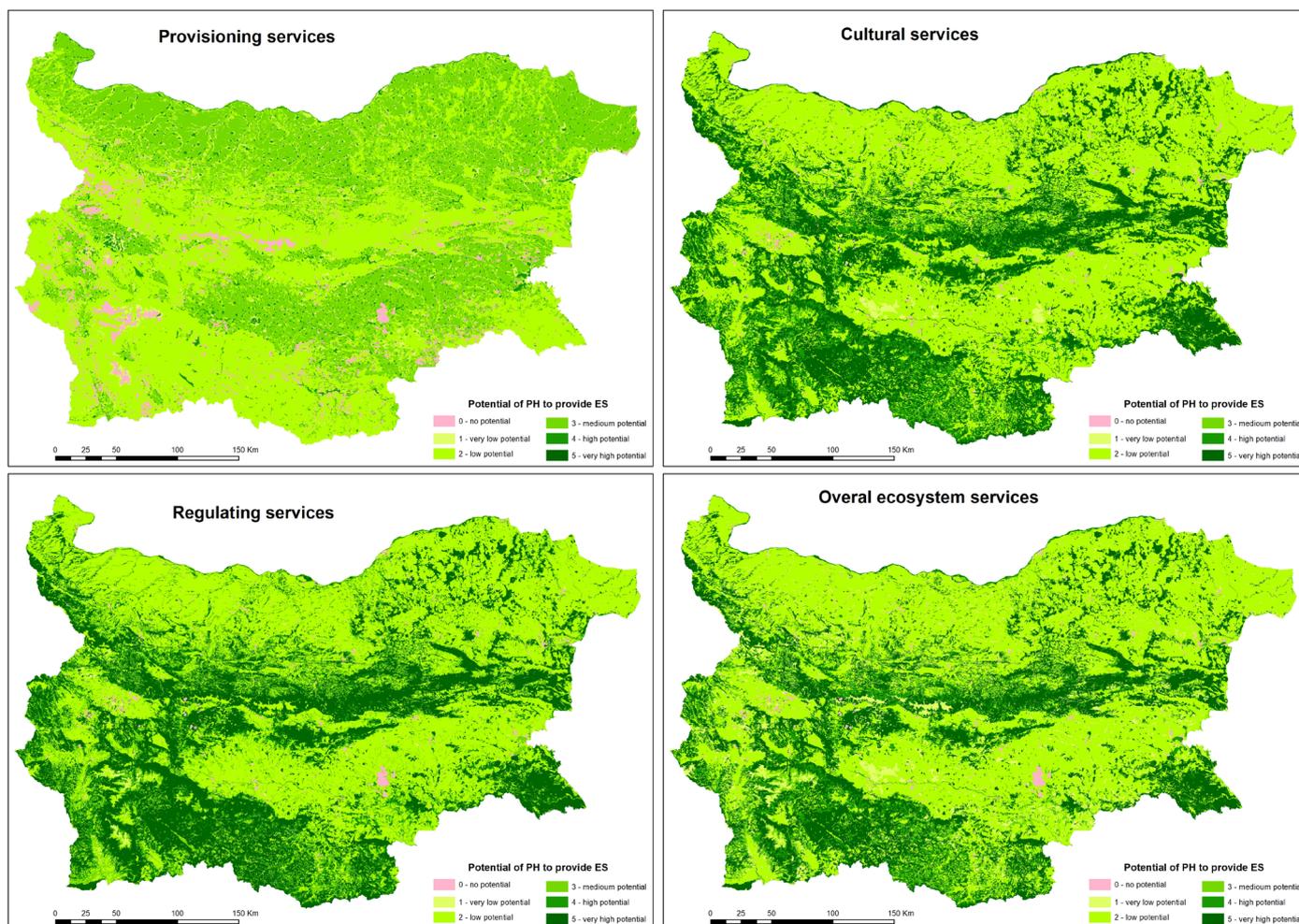


Figure 4. Maps of ecosystem services’ potential for recreation and tourism provided by the NH.

Table 5. Distribution of the ES potential by areas.

ES potential	Polygons (n)	Area (ha)	%
0	1 540	116 466	1.0
1	117	12 294.2	0.1
2	9 776	849 543	7.7
3	23 189	5 773 613	52.0
4	8 902	838 753	7.6
5	11 386	3 508 509	31.6

scores, especially for cultural services. The urban ecosystems had low potential with dump sites estimated to have no potential for all ES.

The scores from the matrix were used to generate ES maps at national level (Fig. 4). The areas of very high potential of the NH were located mainly in the mountain, plateau and hilly areas, as well as in some floodplain with riparian vegetation, where forest ecosystems are the predominant type. Exceptions from this rule were the subalpine areas of Rila Mountain and Pirin Mountain, which have less or almost no forest ecosystems. This pattern is most pronounced for the regulating services, while for the provisioning services the opposite pattern is observed – with lowland areas assessed to have higher potential due to the agricultural ecosystems.

Most of the country’s territory exhibits medium potential. At the same time nearly thirty percent of the country’s territory gained the highest score for potential of the Bulgarian natural heritage for tourism and recreation (Table 5).

4. Discussion

In this study, we analyze the interaction between people and NH in respect to recreation and tourism as a complex and multifaceted process. This process takes part in the form of provision of various ES by the NH, which are demanded by people during their holidays. This interaction can be a win-win situation if people derive a set of

health, aesthetic, cognitive, etc. benefits and opportunities through the recreational activities, while on the other hand, the preservation of the NH is improved as a result of the increase of its societal value. The proposed approach makes it possible to reveal the entire recreational potential of the ecosystems that inherit the value of the NH. It relies on the understanding of the integrative links between the provision of ecosystem services and the needs and motivation to visit natural heritage sites. Furthermore, the approach reveals the needs of recreational industries and the opportunities to develop a multifunctional recreational tourism product based on the NH. Last but not least, the proposed approach reflects the relationship between natural and cultural heritage and their cumulative value, and in this aspect, reflects the need for recreational development of natural heritage sites, as well as the need for their protection.

The study identifies 48 ecosystem services which are related to the NH-based recreation and tourism. Showing a high level of agreement, the experts appointed for the purposes of this study, gave priority to the intangible cultural ecosystem services provided by both biotic and abiotic elements of the NH. However, the results show that some regulation and provisioning ecosystem services are also important in the process of recreational interaction of people with the natural heritage. Therefore, the recreation-related ecosystem services are a set of ecosystem benefits that is not limited to the group of cultural services. Furthermore, the results disprove the simplified understanding that tourism and recreation are separate activities within the complex flow of ecosystem services provided by NH.

The study highlights 15 ecosystem services of various nature – four provisioning, four regulating, and seven cultural, defined as highly important to the recreational potential of ecosystems, provided by the NH at national level. The summarized results of the expert assessment highlight the forest ecosystems as having the highest recreational potential, due to the cultural and regulatory services they provide. Rivers, lakes, and marine ecosystems, as well as coastal dunes, where cultural services dominate, also exhibit a high potential. Wetland ecosystems, screes, rocky terrains, and subalpine shrubs exhibit medium potential. Meadow and agricultural ecosystems are characterized by relatively low recreational potential, while urban ecosystems have the lowest potential. Despite the low overall assessment among urban ecosystems, villages and green areas stand out with their significant recreational potential, which is comparable to that of aquatic ecosystems.

In spatial terms, the mapping of ecosystem services provided by the NH, demonstrates the significant recreational potential of the natural heritage of Bulgaria. The results show that only about 9 % of the country's territory have limited opportunities to provide services of good quality for recreation and tourism activities. High and very high recreational potential has been established for 49.2 % of the country's territory, while the rest of the territory exhibits average recreational opportunities. This distribution of the recreational potential is determined by the spatial model of the flows of various ecosystem services. The potential of cultural services practically coincides with that of regulatory services, outlining the territories occupied by mountains, forests, and water bodies as the most important from the point of view of recreation and tourism. The potential of the provisioning services takes a mirror image of other services, adding plains, valleys and lowlands to potentially important areas for the development of recreation and tourism.

The expert-based ES assessment enables a fast and easy way to reveal the relevance of ES provided by the NH to recreation and tourism (Prodanova, 2021). The critical point in such an assessment is the precise and clear definition of the assessment criteria and their correct interpretation by the experts. The interdisciplinary

character of ES assessment necessitates the involvement of experts from various fields, who might have different interpretations of the assessment criteria based on the specifics of their expertise. The experience of the experts in ES studies is another important factor – the scores which exhibited the highest deviation were given by the experts with less experience in ES studies. Some of the experts tend to underestimate, while others exaggerate the significance of the ES provided by the NH to recreation and tourism.

5. Conclusion

The five-stage approach proposed in this study facilitates the prioritization of ES provided by the NH for the needs of recreation and tourism. The application of the ESPM sets the stage for the selection of measurable parameters (Werner et al., 2014). In our case, we applied the assessment criteria to the selected CICES classes in order to estimate their relevance to recreation and tourism.

The application of the proposed approach allowed us to distinguish three groups of importance of the ES: high-, medium- and low-priority ES. The first group contains obligatory ES for each mapping and assessment activity from national to local level. The second group contains optional ES recommended for studies at regional level, where the ES can be selected according to the specifics of the study. The low-priority ES are recommended for local level studies in cases where the assessment requires high detailization and accuracy.

The mapping of high-priority ES at national level shows that the products of the approach can be easily adapted using conventional mapping methods. The resulting maps illustrate well the potential of the NH to provide ES related to recreation and tourism. Further applications at regional and local level are needed in order to verify the prioritization process and test the use of the second and the third ES priority groups.

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Supplementary materials

Suppl. material 1: Selected ecosystem services used for designing the prioritization matrix

Authors: Nedkov S

Data type: Table, .pdf

Brief description: ES used for designing the prioritization matrix

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Size: 94 KB

Link: <https://doi.org/10.3897/jbgs.e73687.suppl1>

Suppl. material 2: ES Prioritization Matrix

Authors: Nedkov S

Data type: Table, .pdf

Brief description: ES numbers correspond to Suppl. material 1

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Size: 105 KB

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