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Research Article

Capacity of Zlatitsa Municipality (Western Bulgaria) to provide ecosystem services

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Keywords

Ecosystem services, CORINE, Zlatitsa Municipality

Abstract

The present research aims at estimating the capacity of the ecosystems in Zlatitsa Municipality to provide certain types of ecosystem services. The case study area is located in the western parts of Bulgaria, and it is a part of Sofia Province. The basis of the study is the CORINE Land Cover (CLC) classification (2018) upon which the Maes typology has been built. Fourteen (14) CLC Classes were distinguished in Zlatitsa Municipality, as well as five (5) ecosystem types. The capacity of the latter to provide ecosystem services was evaluated, based on a six-grade scale. The results of the study include maps of the provisioning, regulating, and cultural service capacity of the area, as well as an overall map of all of them. The research outcomes provided successful results, focusing on the importance of the provision of ecosystem services. They can be applied as a framework for similar studies in the neighboring municipalities.

1. INTRODUCTION

We all depend on the environment, no matter we acknowledge it or not. It supplies us with a palette of resources that are vital to our well-being. Ecosystem investigations are multiplying by the minute, as they are of key importance to the sustainable anthropogenic use of a wide array of natural resources. Moreover, the capability of ecosystems to provide services is under the constant pressure of climate change and the role of scientists in finding ways to deal with this matter is essential.

The interest in the current case study area springs from its natural characteristics that are a basis for the provision of a variety of ecosystems, both natural and ones with significant anthropogenic interference. In addition, an investigation, including an evaluation of the capacity of the ecosystems of the Central Balkan area to provide certain services, was published by several authors (Nedkov et al, 2018). The geographical location of the current study's area is in proximity to the abovementioned territory; thus, it is representing a natural extension of it. Furthermore, the research is expected to add more scientific data to a field that is of present-day significance and will extend the knowledge of the subject of the provision of ecosystem services.

2. LITERATURE REVIEW

The worldwide experience on ecosystem investigations is ample. A study of the possibility of sustaining ecosystem services in ancient limestone grassland, based on the significance of major component plants and community composition, was carried out in 2008 (Phoenix et al, 2008). Another study (Zhang et al, 2010) provides an investigation on the spatiotemporal variation of karst ecosystem service values and its correlation with environmental factors. An assessment of the service value of ecosystems in several ecological control areas was conducted in China (Wu et al, 2012). Another research is based on the local regulatory protection for ecosystem services in the karst region of southeast Minnesota, USA (Williams and Ziegler, 2014). A study of the future of rocky desertification control in karst areas was presented in Southwest China (Zhang et al, 2016). These investigations may be considered as a good starting point, regarding research in karst territories, ones that are occurring in Zlatitsa Municipality, as well. An application of the InVest model as a basis for their research for assessment and mapping of multiple ecosystem services in Guizhou Province was also presented (Han and Dong, 2017).

The narrowing of the geographic context to the European continent displays more regional features of ecosystem research. A survey on grassland ecosystem services in the Czech Republic deserves mention (Zisenis et al, 2011).

Several stepping stones serve as a basis of the current study, regarding Zlatitsa Municipality. Among them is the CORINE Land Cover classification (2018), the MAES typology (Maes et al, 2013, 2014), the matrix for assessing the capacity of ecosystems to provide an array of services (Burkhard et al, 2009, 2012, 2018) and the latest version - 5.1 of the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2018).

As the regional context is being reduced to the local one, namely Bulgaria, there are also several publications, based on ecosystem services, which deserve attention. A study, covering the territory of the Seven Rila Lakes, uses the previously mentioned assessment matrix (Nedkov et al., 2014). There are other investigations (Assenov et al, 2016, 2017; Zhiyanski et al, 2017; Bratanova-Doncheva et al, 2017; Nedkov et al, 2017, 2018 and Assenova et al, 2018) that provide an insight in the field of the assessment

and mapping of ecosystem services. Other studies (Dembicz et al, 2021; Tcherkezova et al, 2019 and Seymenov, 2020) also contribute to existing ecosystem knowledge.

3. CASE STUDY AREA

The case study area of the current investigation is represented by Zlatitsa Municipality. It is located in the western part of Bulgaria, more specifically – in the eastern parts of Sofia Province. The area covers 163.27 km2, taking 15th place among all municipalities of the province. The interest towards Zlatitsa Municipality was sparked also by a certain uniqueness, regarding its territorial extent. Together with Krichim Municipality, they are the only ones in the country that are consisting of two disjoint areas (Fig. 1). The first of these sections of Zlatitsa Municipality holds the urbanized area of the town of Zlatitsa and the other contains the territory of Petrich village. The two areas of Zlatitsa Municipality are separated by Chavdar Municipality. The other borders of the case study area include the following municipalities: to the east is Pirdop Municipality, to the west, alongside the already mentioned Chavdar Municipality, is also Chelopech Municipality. To the north are the municipalities of Teteven and Etropole and to the south – Panagyurishte Municipality. All of these surrounding territories are bound to the main area of Zlatitsa Municipality. The borders of the smaller section are to the north and west is Mirkovo Municipality, Chavdar Municipality is located to the east, and Panagyurishte Municipality is situated in the southern direction.

The geological features of Zlatitsa Municipality are diverse. Magmatic, sedimentary, and metamorphic rocks are found throughout the whole territory. Granitized biotites, two-mica gneisses, migmatites, granite-gneisses, gneisses, amphibolites and silimanite-garnet schists can be encountered through most parts of the area. The metamorphic rocks are also represented by metamorphosed shales, shales. Magmatic rocks and volcanic rocks are represented by diabases, keratophyres, and their tuffs, andesites, dacites, andesitobasalts in extrusive, explosive and subvolcanic. The sedimentary facies is accompanied by drift sediments, sandstones, siltstones, marls, grey and red limestones, limestones with flint and coal.

The relief is predominantly mountainous. To the north is Zlatishko-Tetevenska Mountain, which is a part of the Central Balkan Range. The highest point of the case study area is Svishtiplaz Peak (1888.3 m a.s.l.). The whole northern section of Zlatitsa Municipality falls within the high mountainous belt of the country, extending over 1600 m a.s.l. The southern parts of the investigated area are taken by the northern slopes of Sashtinska Sredna Gora Mountain with Malka Bratia Peak (1406 m a.s.l.) and the northeastern slopes of Belitsa Ridge, which is a part of Ihtimanska Sredna Gora Mountain. The Balkan and Sredna Gora mountain ranges are separated by Zlatishko-Pirdopska Valley. The lowest point of Zlatitsa Municipality is located to the south of Petrich Village and is as low as 447 m a.s.l.

The investigated area falls within the temperate climate zone, and this has an impact of the water richness. The main catchment area is the one of Topolnitsa River, which flows through both disjoint sections. More or less the other rivers in the municipality are a part of its basin. Among them are the arteries of Balandere, Slavtsi, Kurudere, Tsarkveshtenska, Kiseleshko dere, Gazibara, Smolska, Kameniyska reka, Angelov dol, Dobri dol and Disagov dol.

The soil features are, as diverse, as the other physical components. If we study them from south to north, we will discover that several soil types stand out. The strongly leached to slightly podzolized (lessive) cinnamonic forest soils (chromic, Luvisols, LVx)

are followed by secindary sadded brown forest soils (eutric Cambisols, CMe). As we go in northern direction, rendzinas (humus-calcareous) (rendzic Leptosols, LPk) soils appear, accompanied by leached cinnamonic forest, heavy loamy to slightly clayey soils (chromic, Luvisols, LVx). The last soil type to the far north is the deluvial and deluvial-meadow, sandy and loamy, mainly stony soil (dystric Colluvisols, CLd).

Over 50% of Zlatitsa Municipality is designated as a protected area, following Council Directive 92/43/EEC or the Habitat Directive, with Tzentralen Balkan – buffer site (BG0001493) to the north and Sredna Gora (BG0001389) site to the south. Less than 50% are protected by the Birds Directive (Directive 2009/147/EC) with the presence of Sredna gora (BG0002054) site. The national legislation of the Republic of Bulgaria recognizes one protected area, situated near Petrich Village. This is the site of Vran kamak (Code 121), covering a territory of 60.6 ha.

3.1 Theoretical implications

The present investigation is developed based on the CORINE Land Cover 2018 classification. It interprets its classes as geospatial units that are later applied to identify the ecosystem types (Maes et al, 2013, 2014). These ecosystem units are the ones that will eventually undergo an evaluation process, based on the choice of particular ecosystem service classes of the CICES classification (Haines-Young and Potchin, 2018), version 5.1. Each ecosystem type by the MAES typology supplies several ecosystem goods and services. The current study will discuss some of them, but not all, because this is not a focus of it. The prioritization of the ecosystem services is covered by a team of experts who provide the evaluation and assessment. The grading is constructed upon the matrix for assessing the capacity of ecosystems to supply us with services (Burkhard et al, 2009, 2012, 2018). The matrix consists of 6 categories, ranging from 0 – no capacity to 5 – very high relevant capacity. The names of the CICES classes are cut down in some places to simplify the presented information. For instance, the class “regulation of temperature and humidity, including ventilation and transpiration” has been shortened to “regulation of temperature and humidity”.

3. ANALYSIS

3.1 CORINE Land Cover

The display of the results of the investigation will start with the CORINE Land Cover classes as of 2018 that are a part of Zlatitsa Municipality (Fig. 1). The legend is consisting only of the codes of the different classes for easier reading. The information that each code holds is presented in Table 1.

As it can be assumed from the territorial extent of the classes above, it is evident that forests are dominating the landscape with broad-leaved forests (65.95 km2) upfront. At the back end are mineral extraction sites, dump sites, and sparsely vegetated areas with less than 1 km2 cover by each. These features of Zlatitsa Municipality will surely have an impact on the differentiation of the ecosystem types. The area comprises of a total number of 14 CLC classes in level 3, as it can be discovered from Table 1.

Figure 1. CLC classes for 2018 in Zlatitsa Municipality

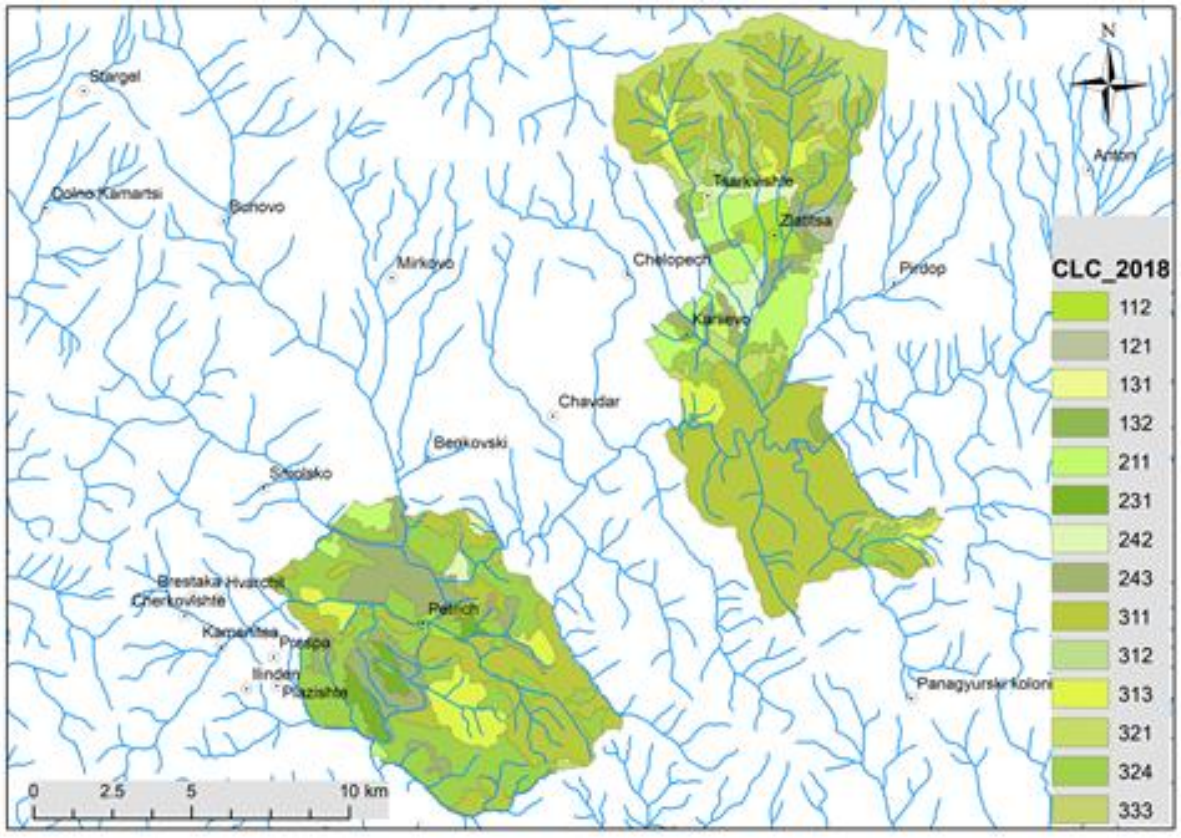


Table 1. CORINE Land Cover classes for Zlatitsa Municipality

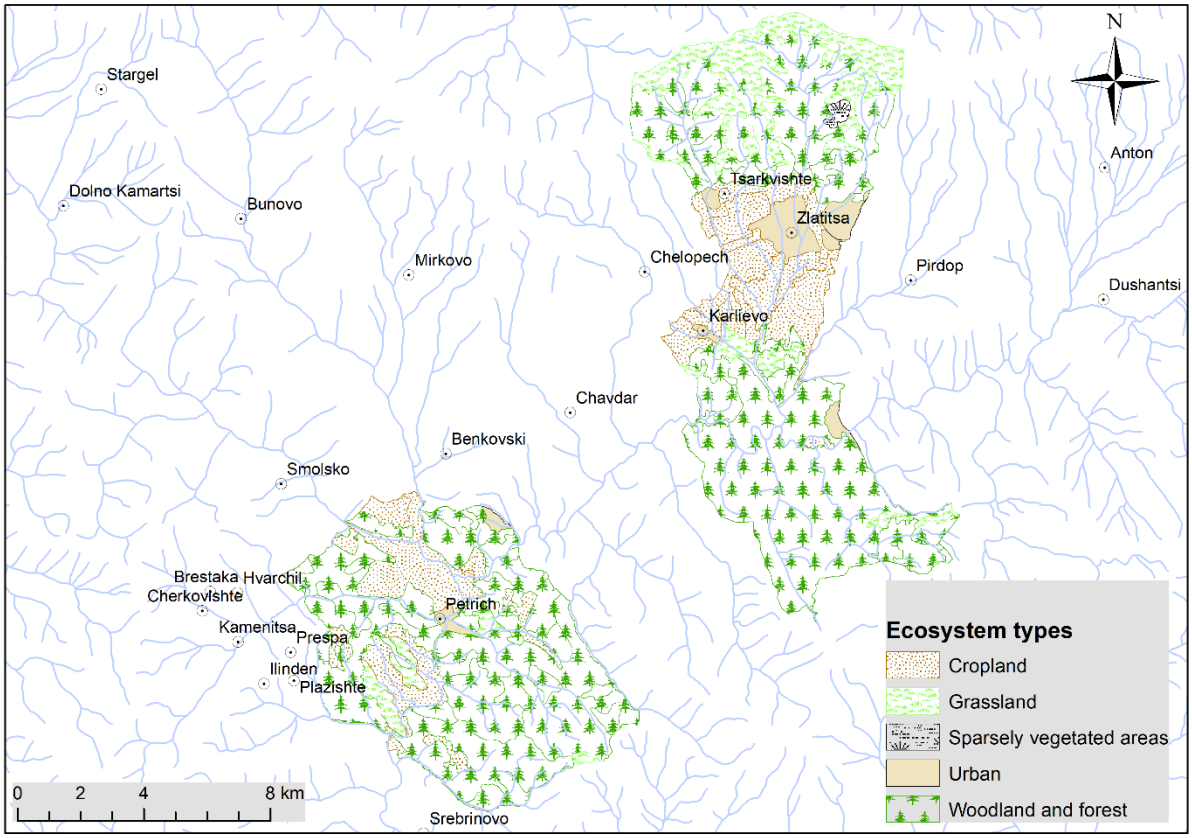
CORINE Land Cover classes at Level 3	Area (km^2)
112 Discontinuous urban fabric	3.55
121 Industrial or commercial units	1.25
131 Mineral extraction sites	0.34
132 Dump sites	0.83
211 Non-irrigated arable land	10.76
231 Pastures	2.47
242 Complex cultivation patterns	3.98
243 Land principally occupied by agriculture, with significant areas of natural vegetation	15.92
311 Broad-leaved forests	65.95
312 Coniferous forest	1.12
313 Mixed forests	10.71
321 Natural grasslands	14.65
324 Transitional woodland-shrub	31.28
333 Sparsely vegetated areas	0.45

Source: Copernicus, Europes's Eyes on Earth - https://land.copernicus.eu/pan-european/corine-land-cover

3.2 Ecosystem types

The diversity of classes of the CORINE Land Cover is processed to reveal the differences between the ecosystem types in the area. The case study territory comprises of 5 distinct ecosystems (Fig. 2). Table 2 represents the interaction between the CORINE Land Cover classes and the ecosystem types.

Figure 2. Ecosystem types in Zlatitsa Municipality



The differentiation of the various CLC classes and their alignment follows some apparent circumstances. For example, there is no other ecosystem type than the "Urban" one that is more appropriate for the following classes: 112 - discontinuous urban fabric, 121 - industrial or commercial units, 131 - mineral extraction sites, and 132 - dump sites. Class 243 - land principally occupied by agriculture, with significant areas of natural vegetation is put into the "Cropland" ecosystem type due to its general appearance and presence of cultivation patterns. Probably the trickiest part was the determination of the affiliation of class 324 - transitional woodland-shrub. MAES typology includes the ecosystem type "Heathland and shrub", which can be regarded as an appropriate one for class 324. However, the satellite images of these particular territories show the presence of significant territories, covered with woods; therefore, this class was assigned to the "Woodland and forest" ecosystem type.

The analysis of the ecosystem types shows that the "Woodland and forest" type is taking the largest share of the whole area, meaning that this ecosystem may be expected to have the most significant influence on the provision of certain types of ecosystem goods and services. Forests have a general distribution and are lacking mainly in the central parts of the municipality, namely the Zlatishko-Pirdopska Valley. Broad-leaved forests of the alliances *Quercion petraeo-cerridis, Carpinion betuli* and *Fagion sylvaticae*, consisting of *Quercus robur* **L.**, *Quercus cerris* **L.**, *Quercus frainetto* **Ten.**, *Quercus dalechampii* **Ten.**, *Quercus pubescens* **Willd.**, *Fagus sylvatica* **L.**, *Carpinus betulus* **L.**, *Acer campestre* **L.**, *Acer platanoides* **L.**, *Acer pseudoplatanus* **L.**, *Fraxinus excelsior* **L.**, *Fraxinus ornus* **L.**, *Tilia tomentosa* **Moench,** *Tilia cordata* **Mill.**, *Tilia platyphyllos* **Scop.,** and *Betula pendula* **Roth.** are regarded as the most typical for the area. They are accompanied by several dominating coniferous species, such as *Pinus sylvestris* **L.**, *Pinus nigra* **J. F. Arnold**, *Pinus strobus* **L.**, *Picea abies* **(L.) H.**

Karst, *Abies alba* **Mill.** and *Pseudotsuga menziessi* **(Mirb.) Franco** that are present in mixed forests. These communities have an understory of the alliances *Berberidion vulgaris* and *Carpinion orientalis* with the species *Rosa canina* **L.,** *Crataegus monogyna* **Jacq.**, *Prunus spinosa* **L.**, *Cornus mas* **L.** and *Carpinus orientalis* **Mill.**

Table 2. CORINE Land Cover classes to Ecosystem types

CORINE Land Cover classes at Level 3	Ecosystem type	Area (km^2)
112 Discontinuous urban fabric	**Urban**	5.96
121 Industrial or commercial units		
131 Mineral extraction sites		
132 Dump sites		
211 Non-irrigated arable land	**Cropland**	30.67
242 Complex cultivation patterns		
243 Land principally occupied by agriculture, with significant areas of natural vegetation		
231 Pastures	**Grassland**	17.12
321 Natural grasslands		
311 Broad-leaved forests	**Woodland and Forest**	109.07
312 Coniferous forest		
313 Mixed forests		
324 Transitional woodland-shrub		
333 Sparsely vegetated areas	**Sparsely vegetated land**	0.45

Source: Copernicus, Europes's Eyes on Earth - https://land.copernicus.eu/pan-european/corine-land-cover

The "Cropland" ecosystem type takes the second place when it comes to territorial extent. Croplands are distributed mainly in easily accessible places, both for people and for agricultural machinery. Zlatishko-Pirdopska Valley is ideal for agriculture so it is not a surprise that the largest proportion of croplands can be discovered there. Another agricultural territory is located to the north of Petrich Village - in the smaller of the two disjointed sections.

The "Grassland" ecosystem type comprises of natural grasslands and pastures, thus the mountainous areas are more typical for it. Zlatishko-Tetevenska Mountain to the north and Sredna Gora Mountain to the south are the main areas, hosting grasslands in Zlatitsa Municipality. Grasslands are represented by the phytocoenoses of the classes *Festuco-Brometea, Molinio-Arrhenatheretea, Epilobietea angustifoliae*, *Chenopodietea, Polygono-Poetea annuae*. Here the dominating species are: *Festuca valesiaca* **Schleich. ex Gaudin**, *Poa nemoralis* **L.**, *Festuca heterophylla* **Lam.**, *Luzula luzuloides* **(Lam.) Dandy**, *Melica uniflora* **Retz.,** *Dichanthium ischaemum* **(L.) Roberty**, *Chrysopogon gryllus* **(L.) Trin.**, *Poa pratensis* **L.**, *Briza media* **L.,** *Trifolium repens* **L.** and *T. pratense* **L.**

The vastest urbanized lands are including the town of Zlatitsa and the villages of Tsarkvishte, Karlievo, and Petrich to the northwest and to the southwest of the main town, respectively. There is only one polygon with sparsely vegetated land. It can be found in the northern parts of the municipality in an area where erosion has taken its toll and favorable conditions for the formation of dense vegetation cover are missing.

3.3 Ecosystems' capacity to provide services

The main task of the current investigation is to uncover the capacity of all ecosystem types in Zlatitsa Municipality to provide several services for human well-

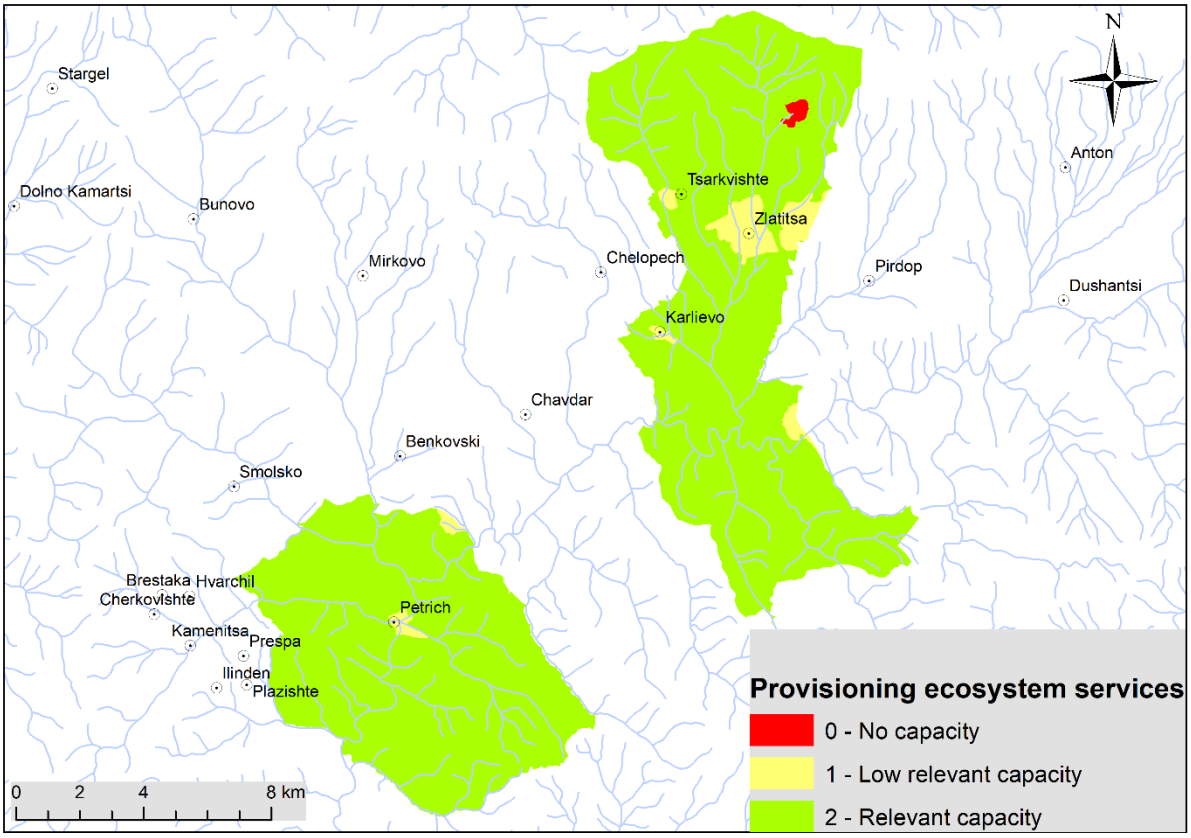
being. Several classes of the CICES Classification (v.5.1) were differentiated, based on their relevance to the investigated area and they are displayed in Table 3. These classes are united in three different categories of ecosystem services: provisioning, regulating, and cultural with the first two categories containing 6 distinct CICES classes and the latter – 3 classes. The expert team determined the score of each ecosystem, based on a scale from 0 to 5. The higher the capacity of an ecosystem type to provide services, the bigger the mark it has been granted. There are four additional columns, except for those displaying a certain ecosystem service. They comprise the average scores of each of the three categories of ecosystem services with the last one, containing the average score of all categories. The marks of each ecosystem are strictly influenced by the type of ecosystem service. That is why the "Woodland and forest" and the "Sparsely vegetated land" ecosystem types have the lowest score when it comes to the provision of cultivated terrestrial plants, for instance.

Table 3. The capacity of the ecosystems to provide services

ES type	Cultivated terrestrial plants	Reared animals	Wild plants	Wild animals	Water	Fibers and other	**Average Provisioning**	Control of erosion rates	Flood control	Pollination	Maintenance of habitats	Disease control	Regulation of temperature and humidity	**Average Regulating**	Health, recuperation or enjoyment	Scientific investigation	Aesthetic experiences	**Average Cultural**	**Average all**
Urban	1	1	1	1	1	1	**1**	2	2	2	1	1	2	**1.7**	1	2	1	**1.3**	**1.3**
Cropland	5	2	1	2	2	1	**2.2**	2	2	3	1	2	2	**2**	1	3	1	**1.7**	**2**
Grassland	1	4	4	4	2	2	**2.8**	3	2	5	4	3	2	**3.2**	3	4	4	**3.7**	**3.1**
Woodland and forest	0	1	4	4	4	4	**2.8**	5	5	5	4	4	5	**4.7**	5	5	5	**5**	**4**
Sparsely vegetated land	0	1	1	1	1	0	**0.7**	1	0	1	1	0	1	**0.7**	1	3	3	**2.3**	**1**

Next will be presented the separate provisioning, regulating and cultural services that the ecosystem types of Zlatitsa Municipality are providing, starting in the abovementioned order. Figure 3 displays the first category of ecosystem services.

Figure 3. Provisioning services of Zlatitsa Municipality.



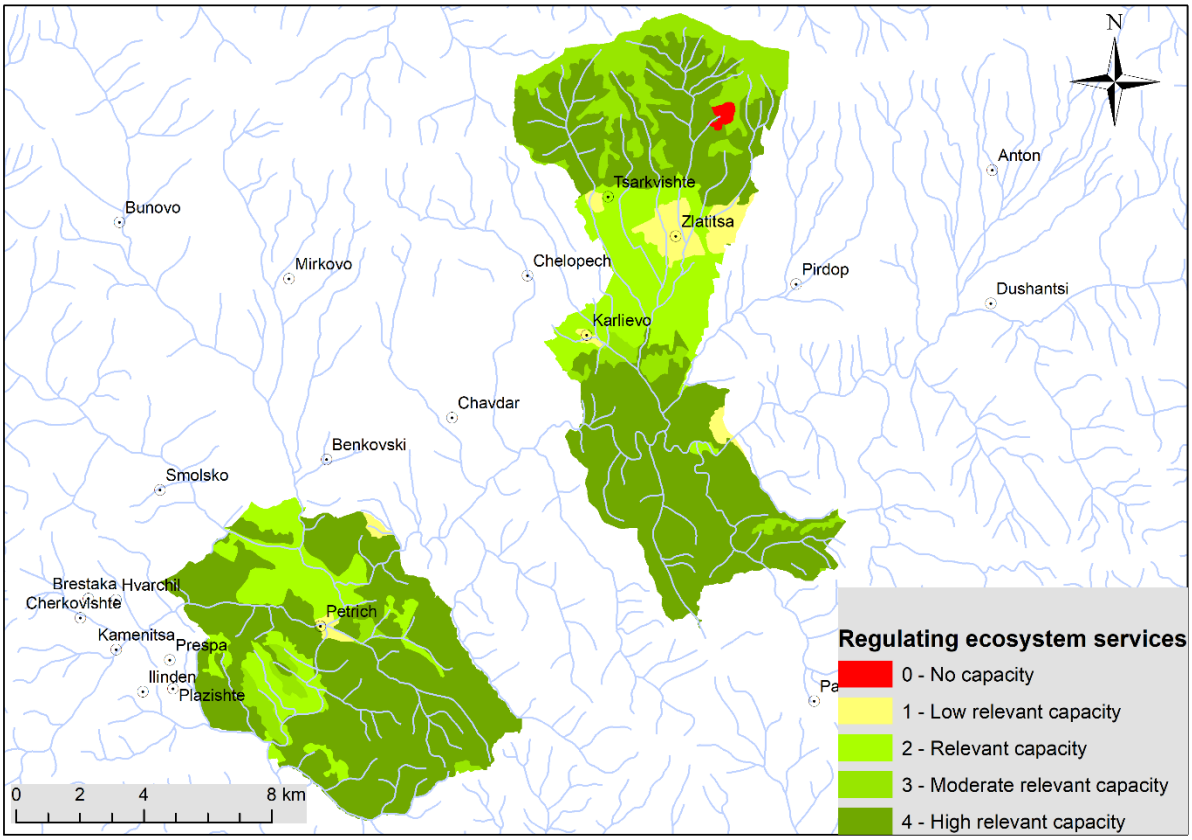
The largest proportion of the territory (over 96%) has been asserted the grade “2” or “relevant capacity”, following its capacity to supply us with the six examined provisional ecosystem services (cultivated terrestrial plants, reared animals, wild plants, wild animals, water, fibers and other). The predominantly mountainous terrain is a decent provider of this category of ecosystem services and the map proves that. The “Woodland and forest” and “Grassland” ecosystem types have been awarded the highest average marks – 2.8. Only 3% of the territory has low relevant capacity to supply us with provisioning ecosystem services.

At this point, an important observation be made as there is a specific detail in the spatial process. The digits before the decimal point are the most essential. Although the previously mentioned ecosystem types have reached almost reached grade “3”, the mark is still “2.8”. Therefore, they have a “relevant capacity” and not a “moderate relevant capacity”, even though this presumption is on the contrary with the mathematical rule of rounding.

Less than 1% of the area cannot provide this category of ecosystem services and it is represented by the sparsely vegetated land that is located to the north of the town of Zlatitsa.

Figure 4 and Table 3 display the capacity of the ecosystems in the investigated area to provide regulating services (control of erosion rates, flood control, pollination, maintenance of habitats regulation of temperature and humidity, and disease control).

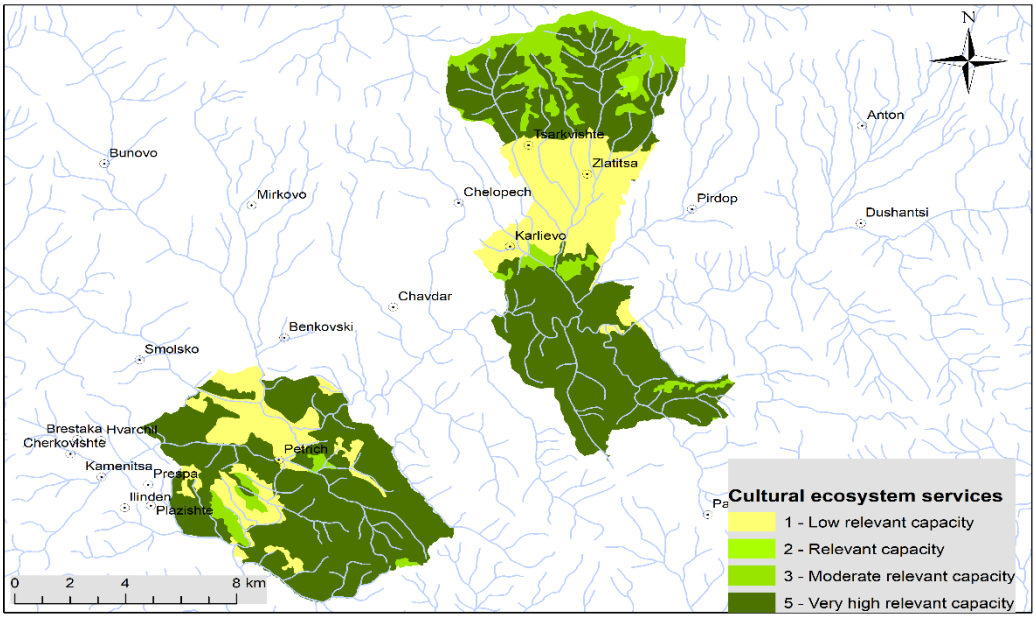
Figure 4. Regulating services of Zlatitsa Municipality.



The mountainous territories of the Balkan Range and Sredna Gora Mountain are awarded the highest grade – in this case with “high relevant capacity or 4”. This is the mark of the “Woodland and forest” ecosystem type, taking up to 66.8 % of the whole territory. It even gets the highest score of “5” in four of the six assessed CICES classes. The “Grassland” ecosystem type has a “moderate relevant capacity” to provide regulating ecosystem services. Grasslands account for 10% of the area. At the same time, agricultural territories have been assessed with a “relevant capacity” (18.8%). The “Urban” ecosystem type takes 3.7% of the territory and scores a “low relevant capacity”. Once again, the type of “Sparsely vegetated land” (less than 1%) possesses no capacity to provide ecosystem services.

The capacity of the area to provide cultural services is presented in Figure 5 and Table 3. Once again, the indisputable leader in supplying us with cultural ecosystem services (health, recuperation or enjoyment, scientific research, and aesthetic experience) is the ecosystem type of “Woodland and forest”. This is the only place where all grades are the top ones; therefore 66.8% of the municipality has a very high relevant capacity to provide cultural ecosystem services. Broad-leaved forests, which are native for this area, possess the highest necessary capacity to provide cultural ecosystem services. The highest grade here may be explained by the fact that since ancient times forests have been regarded as spiritual places of great influence and nowadays their status is becoming even more significant, as intact forests are diminishing all over the world.

Figure 5. Cultural services of Zlatitsa Municipality.



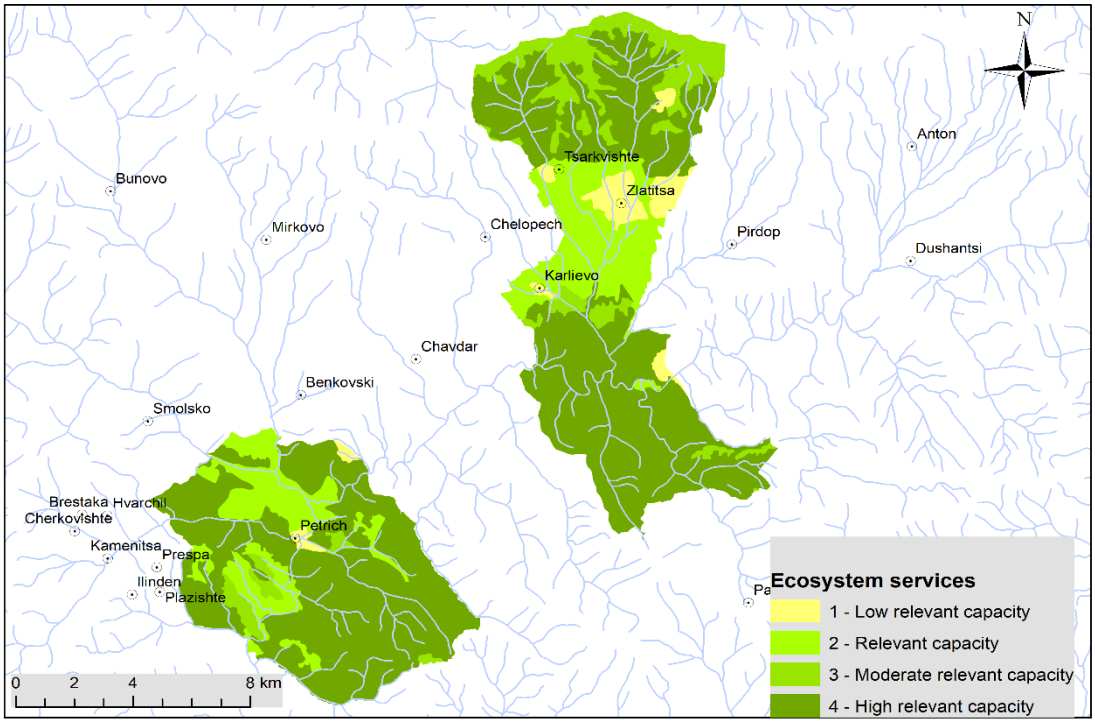
The “Grassland” ecosystem type is considered to provide a moderate relevant capacity and it is taking over 10% of the territory of Zlatitsa Municipality. Grasslands also have several species that are suitable for scientific investigation, studying, or just serve for aesthetic experience. This may be the reason for their higher grade, compared to other ecosystem types.

A moment that deserves attention is the evaluation of the type of “Sparsely vegetated land”. It is covering less than 1% and until now it has been graded with the lowest marks. In this case, the expert team regards this ecosystem type, as more capable of providing cultural ecosystem services than the “Urban” and the “Cropland” types that are awarded the lowest grade here – 1 or “low relevant capacity”. Yet, due to their broader distribution, 23% of the area of Zlatitsa Municipality possesses the already mentioned low capacity. Sparsely vegetated land possesses a decent degree of naturalness, compared to anthropogenic and agricultural territories and probably that is the main reason behind their higher capacity to provide cultural ecosystem services.

The last paragraphs of the analysis section are dedicated to the overall capacity of the territory to provide ecosystem services. Figure 6 points out the main territorial differences in Zlatitsa Municipality, regarding the supply of provisional, regulating, and cultural ecosystem services

The assessment here falls within the grading range from 1 to 4, meaning that in general, the case study area ensures the presence of services in a more stable manner, without the extreme ends of the highest and lowest values. The ecosystem type of “Woodland and forest” is the champion in terms of ecosystem service supply, and it is regarded to be possessing high relevant capacity. Among all types of ecosystems, the species richness, and characteristics of the forests in Zlatitsa Municipality assure the presence of certain environmental conditions that are the main reason behind the highest grading, compared to the other ecosystem types. The fact that forests were graded with “4” is good news from another point of view as well. The ecosystem type of “Woodland and forest” is taking up the biggest proportion of the investigated area (109.07 km2), which means that the largest territory provides the best ecosystem services.

Figure 6. Capacity of Zlatitsa Municipality to provide ecosystem services.



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The naturalness of grasslands along with their species diversity ranked them in second place with their moderate relevant capacity. However, this time the territorial extent of the discussed ecosystem type (17.12 km2) is lower than the one of the "Cropland" ecosystem type (30.67 km2), which possesses a lower overall capacity.

The ecosystem types of "Sparsely vegetated land" and "Urban" are evaluated with a low relevant capacity. The reason behind the lowest overall marks of these ecosystem types may lay in the lack of a complete vegetation cover, accompanied by high species richness. Along with other physical components of the environment, vegetation plays a key role for the provision of ecosystem services, so the absence of it in the discussed territories is compromising their ability to supply us with decent set of ecosystem services.

4. CONCLUSIONS

The assessment here falls within the grading range from 1 to 4, meaning that in general, the case study area ensures the presence of services in a more stable manner,

without the extreme ends of the highest and lowest values. The ecosystem type of "Woodland and forest" is the champion in terms of ecosystem service supply, and it is regarded to be possessing high relevant capacity. It is evident that among all types of ecosystems, the species richness and characteristics of the forests in Zlatitsa Municipality assure the presence of certain environmental conditions that are the main reason behind the highest grading, compared to the other ecosystem types. The fact that forests were graded with "4" is good news from another point of view as well. The ecosystem type of "Woodland and forest" is taking up the biggest proportion of the investigated area (109.07 km2), which means that the largest territory provides the best ecosystem services. The naturalness of grasslands along with their species diversity ranked them in second place with their moderate relevant capacity. However, this time the territorial extent of the discussed ecosystem type (17.12 km2) is lower than the one of the "Cropland" ecosystem types (30.67 km2), which possesses a lower overall capacity. The ecosystem types of "Sparsely vegetated land" and "Urban" are evaluated with a low relevant capacity. The reason behind the lowest overall marks of these ecosystem types may lay in the lack of a complete vegetation cover, accompanied by high species richness. Along with other physical components of the environment, vegetation plays a key role in the provision of ecosystem services, so the absence of it in the discussed territories is compromising their ability to supply us with a decent set of ecosystem services.

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