PAPERS/RAZPRAVE

SYSTEMATIC MAPPING OF STUDIES ON ECOSYSTEM SERVICES IN SLOVENIA

SISTEMATIČNO KARTIRANJE RAZISKAV O EKOSISTEMSKIH STORITVAH V SLOVENIJI

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ABSTRACT
Systematic mapping of studies on ecosystem services in Slovenia
Ecosystem services (ES) are the benefits people receive from ecosystems and a key tool for assessing the sustainability of natural resource use. Natural resource management requires consistent data on the state of ES; despite this, no such research has been carried out at the national level in Slovenia. The purpose of the article is to create an overview of past ES studies in Slovenia. The method of systematic mapping was used. We identified, compared, and described data on ES studies that have been published in Slovenia. The key findings are: 1) the number of ES studies in Slovenia is increasing, however the share of studies focused solely on ES has been decreasing since 2015; 2) the most represented field is forestry and the forest is the most commonly examined ecosystem; 3) the prevailing ES groups are regulating ES, while the most commonly explored individual ES are cultural ES, namely recreation and ecotourism, and 4) the most commonly implemented methodological approach is narrative analysis.

KEY WORDS
ecosystem services, ecosystem, systematic mapping, literature overview, Slovenia

IZVLEČEK

Sistematično kartiranje raziskav o ekosistemskih storitvah v Sloveniji

Ekosistemske storitve (ES) so koristi, ki jih ljudje prejemajo od ekosistemov, in so eno ključnih orodij za presojo trajnosti rabe naravnih virov. Za upravljanje z naravnimi viri so nujni konsistentni podatki o stanju ES, a takšne raziskave na nacionalni ravni v Sloveniji še ni. Namen članka je pregledati pretekle raziskave ES v Sloveniji. Uporabili smo metodo sistematičnega kartiranja. Identificirali, primerjali in opisali smo podatke o objavljenih raziskavah o ES v Sloveniji. Ključne ugotovitve so: 1) število raziskav ES v Sloveniji raste, a se od 2015 zmanjšuje delež osredotočenih zgolj na ES; 2) najbolj zastopano področje je gozdarstvo, gozd pa največkrat preučevan ekosistem; 3) med skupinami ES prednjačijo uravnalne, najpogosteje obravnavana posamezna ES je kulturna ES, in sicer rekreacija in ekoturizem; 4) najpogosteje uporabljen metodološki pristop je narativna analiza.

KLJUČNE BESEDE

ekosistemske storitve, ekosistem, sistematično kartiranje, pregled literature, Slovenija

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1 Introduction

Ecosystem services (hereinafter: ES) are the benefits people receive from ecosystems (MEA 2005) and have been established as one of the key tools for assessing the sustainability of natural resource use. As such, they have become an indispensable element of numerous sectoral policies and strategic initiatives. They are used mainly in environment-related policies of the European Union (EU) (Bouwma et al. 2017), such as the Green Infrastructure – Enhancing Europe's Natural Capital (Zelena … 2013), EU Biodiversity Strategy for 2020 (Strategija … 2011), the New EU Forest Strategy (Nova … 2013), and the Regulation on the Prevention and Management of the Introduction and Spread of Invasive Alien Species (Uredba … 2014). The concept has also been included in the new EU Biodiversity Strategy for 2030 (Strategija … 2020). The Slovenian legislation does not specifically mention ES; however, they are included in the following programme and strategic documents as a way to include European environmental policies: Rural Development Programme of the Republic of Slovenia for the period 2014–2020 (Program razvoja … 2015), Slovenian Development Strategy 2030 (Strategija … 2017), Natura 2000 Management Programme (Program upravljanja … 2015), and the National Environment Action Programme with programmes of measures until 2030 (Resolucija … 2020).

One of the foundations for policy implementation is a reliable and relevant information database that provides insight into the issue the policy is trying to address. In the case of ES, these are databases at different spatial levels that enable ES to be evaluated, their state to be monitored, and various management scenarios to be prepared. Ideally, such databases also contain biophysical and socioeconomic data, and they can be originally based on nationally managed registers (for example, those of the Statistical Office of Slovenia) or they are the result of individual studies. Even though the overview and analysis of such data is a key phase in designing and implementing the abovementioned policies, this has not yet been carried out in Slovenia. We presume that Slovenia is in the initial phases of utilizing the concept of ES, a suspicion that is supported by the country's poor ranking on the barometer of ES implementation in individual EU member states (Kopperoinen, Varumo, and Maes 2018). A similar task to ours has been undertaken by the informal National Partnership of organizations dealing with ES– SOES (BISE 2018); they organize workshops to connect experts on ES research in Slovenia, but the extent is not as comprehensive as this study. The purpose of this article is to present the existing ES studies in Slovenia, define their main characteristics, and identify the knowledge gaps that need to be eliminated in the area in the future so that the concept of ES can start being implemented in Slovenia. The two main research goals are: 1) to present a general overview of the studies (the timeframe of the period 2005–2020, type and language of the research, representation of scientific fields, motives for studying ES) and 2) a detailed analysis of the selected studies (group and individual ES, ecosystems, methods, spatial level).

2 Development of the concept of ecosystem services

The concept of natural capital (Schumacher 1973) was first used in the early 1970s, emphasizing that natural resources are not necessarily limitless and that they must be utilized more prudently for the use to be sustainable. Soon after, a number of authors began systematically researching the issue of non-sustainable use and social welfare, which brought about the development of professional terminology, like »public service functions of the global ecosystem« (Ehrlich, Ehrlich, and Holdren 1977), »nature's services« (Westman 1977); one of the established terms was »ecosystem services«, which was first conceptualized and used by Ehrlich and Ehrlich (1981). ES were established as a concept intended primarily for raising awareness about the negative impacts on biodiversity loss on ecosystem functioning and to demonstrate the interconnectedness between social well-being and ecosystem services (Gómez-Baggethun et al. 2010).

By 2020, the idea of ES had developed into a conceptual framework that enables communication between different stakeholders (government bodies, non-governmental organizations, private companies) and sectors (for example, forestry, agriculture, fishing) about the multi-spectoral importance of ecosystems for the development and survival of society (Barnaud and Antona 2014). Perhaps the greatest breakthrough in the field was achieved by the Millennium Ecosystem Assessment in 2005 (hereinafter MEA), which made one of the most prominent contributions to recognizing how dependent society is on ES and how ecosystems function at the global level. Other key conceptual contributions include: studies on including the value of biodiversity and ecosystem services into all levels of decision-making (The Economics of Ecosystems and Biodiversity … 2010; hereinafter TEEB), strengthening the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2015; hereinafter IPBES), and the mapping and assessment of ecosystems and their services with the European Union (Mapping and Assessment of Ecosystem Services 2011; hereinafter MAES), carried out by the MAES workgroup.

The MAES workgroup formulated 12 ecosystem types for studying ES (seven terrestrial, one freshwater, and four marine types), enabling a structured approach to assessing the state of ecosystems and identifying ES (Mapping … 2011). In addition, three internationally certified classifications of ES have been developed independently from ecosystems: MEA (Millennium … 2005), TEEB (The Economics … 2010), and the Common International Classification of ES (Common International Classification of Ecosystem Services 2018; hereinafter CICES), which present different ways of combining ES into overarching categories and of including different specifics in the classifications. MEA and TEEB divide ES into four groups: provisioning, regulating, cultural, and supporting ES. The CICES classification distinguishes between three ES section: provisioning, regulating, and cultural services, but examines them very systematically and divides them into numerous subcategories. Aside from the ES classifications, a key element of the research are also the methods used to examine ES, which are divided into three main groups: 1) social science methods, which encompass an analysis of the individual's or group's preferences and usually examine the benefits of ES (Kelemen et al. 2016; Harrison et al. 2018); 2) economic assessment methods, which are usually used to analyse the demand or the actual use of ES and are based either on the data on actual market exchanges or on modelling imaginary markets (Hanley, Shogren, and White 2001; Christie et al. 2008; Gómez-Baggethun et al. 2010); and 3) methods for the biophysical assessment of ES, which are most often used to evaluate ES availability (Vihervaara et al. 2017).

At first, ES research developed somewhat tentatively, but has now become a quickly evolving field. Ten years ago, the research challenges in the ES field that researchers (for example, Seppelt et al. 2011) were addressing were general ES examinations, the use of less comprehensive approaches (under-considered interactions among ES), and even lacking reporting on the key research elements. Newer studies (Kull et al. 2015; McDonough et al. 2017; Xie et al. 2020) have detected a shift starting in 2014 that led to a rapid increase of studies at the global level, especially in the countries of the developed world (mostly in the USA) and that the main emphases of ES studies are the effects of land use changes, climate change, and urbanization. Some literature reviews have also been carried out.

Recently, de Groot, Brander, and Solomonides (2020) published an extraordinary work amending the collection of studies on the economic assessment of ES, created as part of the TEEB initiative, supplementing the existing 267 studies in the database with 693 new ones, which constitutes the first substantial upgrade since 2010. Each analysed work was described with 66 different attributes and specifically focused on the methods, approaches to standardizing the economic values, the spatial level aspect, and the temporal dimension of the assessment studies. Campagne et al. (2020) prepared an overview of the studies based on the ES matrix that connects ES assessment with land use. They concluded that the approach was very useful, but that it lacks a clear explanation of the method and the local context with which to amend the ES assessments in the future. Rodela et al. (2019) did an overview of the research that includes an interaction of ES concepts and the common-pool resources. Both concepts address natural resource management from different aspects and they could contribute to new findings in the

field and with a synergetic interplay (especially regarding the role of the community and community practices in managing local natural resources).

Our study differs from the described ones in many ways. It focuses on the theoretical or practical research that is based on data collected in Slovenia. The study includes bachelor's and master's theses as well as doctoral dissertations, not just articles from internationally accessible research databases. Additionally, the analysis casts a more in-depth look on the combinations of the different aspects of the studies, such as the interdependencies of the thematic emphases, the methodological approaches, and the spatial and temporal frameworks.

3 Methods

We tackled ES studies in Slovenia by reviewing the works in Slovenian and English in which domestic or foreign authors addressed ES in Slovenia. We focused on scientific and professional articles that were published in bibliographic databases but purposefully left out ES analyses published in »grey literature« (project studies, websites). The literature overview was implemented using the steps of the systematic mapping method, which was conceptualized in social science, but has been adapted to study the conditions in the environmental field (James, Randall, and Haddaway 2016). In contrast to the systematic overview, which attempts to answer a specific question, systematic mapping focuses on comparing, describing, and cataloguing the available indicators of a specific topic. The indicators in the article that were coded refer to the selected published studies. We followed a six-step methodological framework based on the ROSES protocol (***R**ep**O**rting Standards for **S**ystematic **E**vidence **S**yntheses in Environmental Research;* Haddaway et al. 2017), which ensures the validity and repeatability of the systematic mapping (James, Randall, and Haddaway 2016): 1) establishing the review team, setting the scope and question, scoping the study, and protocol development; 2) searching for the studies, 3) screening the studies, 4) coding the studies, 5) (optional) critical appraisal, and 6) describing and visualizing the findings.

3.1 Establishing the review team, setting the scope and question, scoping the study, and protocol development

The criteria for selecting the studies were: 1) reviewed publications in the Scopus, Web of Science (hereinafter: Wos), or Cobiss (Slovenian library information system) databases, 2) preprepared search string 3) language of the material (Slovenian or English), 4) type of material (scientific and professional articles and monographs, bachelor's and master's theses, dissertations) and 5) time span (January 2005 (publication of the MEA (Millennium … 2005) report) up to 21 August 2020).

3.2 Searching for the studies

The databases were searched using search strings (Figure 1) consisting of the following words: '*ekosistemska storitev*', '*ekosistemske storitve*', '*ecosystem services*', '*ekosistemske funkcije*', '*ecosystem functions*', '*ekosistemske usluge*', '*koristi iz narave*', and '*benefits of nature*', wherein the hits had to relate to Slovenia. We searched for said key search strings in the Scopus and Wos databases in the title, summary, key words, including the subject categories that librarians enter in the Cobiss database. The search returned 236 hits. The hits were merged into one database and 55 duplicated units were removed (duplication within the same database – for example, an electronic and written source, duplication among databases, duplication of the same study and results in the case of theses and dissertations). Part of one study (Šmid Hribar 2014) had subsequently been published in an article by Ribeiro and Šmid Hribar (2019), so both were included in the selection.

Search string in Scopus and Wos

TITLE-ABS-KEY({ekosistemska storitev} OR {ekosistemske storitve} OR {ecosystem services} OR {ekosistemske funkcije} OR {ecosystem functions} OR {ekosistemske usluge} OR {koristi iz narave} OR {benefits of nature})

AND

TITLE-ABS-KEY({Slovenia} OR {Slovenija})

Search string in Cobiss

(("ekosistemsk* storit*" OR "ecosystem services" OR "ekosistemsk* funkcij*" OR "ecosystem functions" OR "ekosistemsk* uslug*" OR "korist* iz narave" OR "benefits of nature")/TI,AB,SU,KW AND (Slovenij* OR Slovenia)/TI,AB,KW) AND PY=2005:2020 AND TD=(1.01 OR 1.02 OR 1.03 OR 1.04 OR 1.16 OR 1.17 OR 2.01 OR 2.02 OR 2.08 OR 2.09 OR 2.11)

Figure 1: Search strings in the Scopus and Wos (above) databases and the Cobiss database (below).

3.3 Screening the studies

In this phase, which initially encompassed 181 units, each unit was examined and the applicability of the contents was additionally assessed. To include all the different grammatical cases, we had included searches with the asterisk (for example, *ekosistemsk**; Figure 1) in the search string in the Cobiss database in the previous phase. This was not compatible with searching for the desired strings in brackets, so noise occurred among the hits (for example, Cobiss returned units that included either the word '*ecosystem*' or the word '*service*'). Similar issues occurred in the Wos database. This led us to remove 66 units whose contents were irrelevant to us. We eliminated 8 units due to an inapplicable material type (for example, panel speech) and another 60 that merely mentioned ES (only in the summary, introduction, or conclusion). An additional 8 units were eliminated, because it was theoretical material co-authored by various Slovenian authors, but the material did not address ES in Slovenia (for example, Burkhard et al. 2018). The selection process in phases 2 and 3 is depicted in Figure 2.

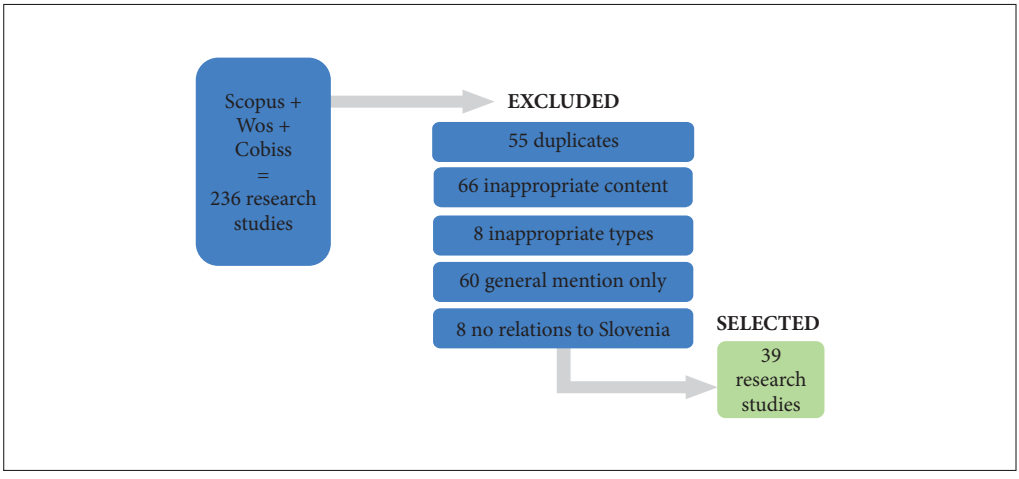


Figure 2: Selection scheme for the relevant studies in accordance with the elimination criteria.

3.4 Coding the studies

The selected units were then coded according to predefined codes (Appendix 1). The first set of indicators referred to general characteristics, as defined in first research goal: 1.1) year of publication, 1.2) article title, 1.3) authorship and scientific field, 1.4) material type, 1.5) language, 1.6) name of the publication in which the material was published, 1.7) motives for the consideration of ES, and 1.8) the level to which ES are addressed (Figure 3). The other set of indicators was tied to ES and addressed the second research goal: 2.1) studied ecosystems per the MAES (Mapping … 2011) typology, 2.2) addressed ES per the MEA (Millennium … 2005) classification, 2.3) use of the ES classification, 2.4) methods for addressing ES, 2.5) spatial level of the ES study, and 2.6) any specific pilot areas. The codes are presented in Appendix 1: Code Book. The studies were coded by pairs of two researchers at a time. In cases of mismatches, all three co-authors of the article would find a common resolution. If any of the authors had participated in a specific study, that study was coded by the other two co-authors.

3.5. Describing and visualizing the findings

The results were compiled into key findings and described and visually illustrated in Chapter 4.

4 Results

4.1 General overview of the studies

The three databases (Scopus, Wos, and Cobiss) returned a total of 236 studies from January 2005 to 21 August 2020 for the search strings from Chapter 3.2. After carrying out the screening process described in Chapter 3.3, we selected 39 suitable studies that address ES in Slovenia (Figure 2).

The number of studies had increased with time (Figure 4, up; Table 1). A surge was recorded after 2015, reaching the pinnacle in 2018. Almost half of the selected studies (n=39) were scientific articles (19; 48.7%), followed by bachelor's and master's theses (6 of each; 15.4%), two professional articles, independent professional component parts, and dissertations, and one scientific and one professional monograph. The earliest two studies were a master's (2008) and a bachelor's thesis (2010). Both dissertations and the majority of the master's theses were published in the period 2014–2016; after that, only one bachelor's thesis dealt with the topic. Scientific articles began being published after 2013, while the two monographs were not published until 2018 (Figure 4, down).

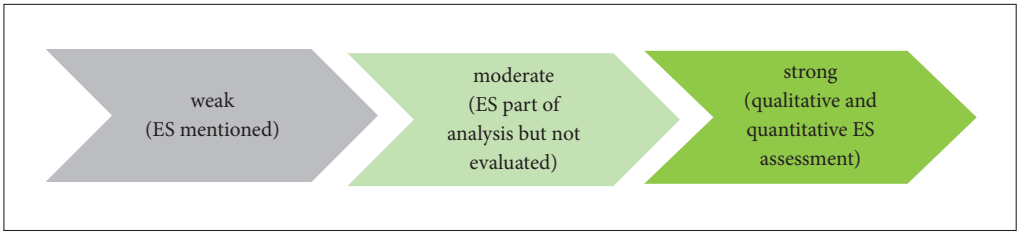
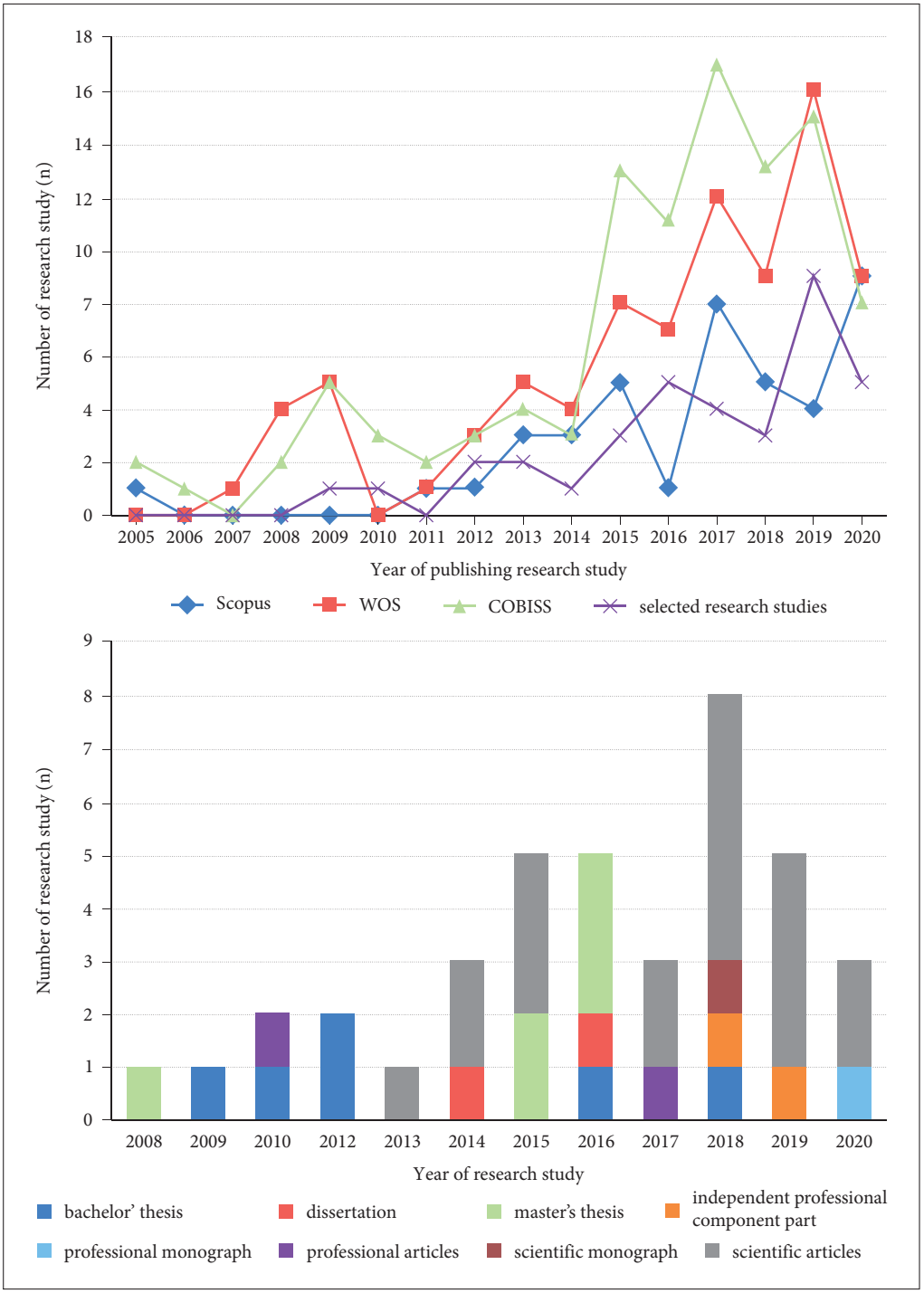


Figure 3: Determining the level to which ES were addressed in the examined studies.

Figure 4: The number of selected studies on ecosystem services in Slovenia from January 2005 to 21 August 2020 in the Scopus, Wos, and Cobiss databases and the number of selected studies in that time period (violet line) (up). The number of studies according to the time and type of research (down).
► *p. 16*


Number of research study (n)
Year of publishing research study
Scopus
WOS
COBISS
selected research studies
Number of research study (n)
Year of research study
bachelor' thesis
dissertation
master's thesis
independent professional component part
professional monograph
professional articles
scientific monograph
scientific articles

Over half of the studies (20; 51.3%) are written in Slovenian and 19 (48.7%) in English. Among the latter, all but one are scientific articles and one is an independent professional component part. Just under two thirds of the studies (25; 64.1%) were written by authors working in the same scientific field; the majority of these were bachelor's and master's theses and doctoral dissertations. Fourteen (35.9%) studies were created as multi/interdisciplinary co-authorship projects covering two or more scientific fields, most of them being scientific articles (Table 1). In addition to that, almost half of the articles were conceived in international co-authorship.

In two thirds of the studies, the leading author had a background in natural sciences, with forestry being the most prominent scientific field; the leading author's primary field was in social science in eleven studies, and in technical fields in two studies. The most represented scientific field out of all the authors of the analysed studies was forestry (26.6%; n=64), followed by geography (17.2%), and agriculture (12.5%).

Table 1: General characteristics of the examined studies (n=39).

variable	category	n	%
Type of study	Scientific articles	19	48.7
	Professional articles	2	5.1
	Independent professional component part	2	5.1
	Scientific monograph	1	2.6
	Professional monograph	1	2.6
	Dissertation	2	5.1
	Master's thesis	6	15.4
	Bachelor' thesis	6	15.4
Language	Slovenian	20	51.3
	English	19	48.7
Scientific field of the leading author	Natural sciences	26	66.7
	Social sciences	11	28.2
	Technical fields	2	5.1
Scientific fields of the authors per article – detailed (n=64)	Forestry	17	26.6
	Ecology and biology	6	9.4
	Agriculture	8	12.5
	Pedology	4	6.3
	Geology (groundwater)	1	1.6
	Energetics	3	4.7
	Geography	11	17.2
	Economy	5	7.8
	Pedagogy	2	3.1
	Spatial planning	1	1.6
	International relations	1	1.6
	Water science	5	7.8
Co-authorship	One scientific field	25	64.1
	Multi/interdisciplinary	14	35.9
Level to which ES were addressed	Weak	11	28.2
	Moderate	11	28.2
	Strong	17	43.6

Other scientific fields (for example, ecology and biology, economy, pedology) were covered less often. The fields of forestry, geography, agriculture, and pedology were featured in at least three or more types of studies. In terms of the diversity of the addressed ecosystems, we found that the authors that were from different scientific fields would generally examine one specific ecosystem. The exception are authors in the field of geography, where over half the studies address multiple ecosystems or an entire cultural landscape in which multiple land use types are present (Figure 5).

The array of journals that published the scientific and professional articles was diverse: 17 journals, of which only three were domestic, the rest were international. In most cases, only one article was published in each of those magazines, the only exception being journals on forestry (*Forest*, *Forest Policy and Economics* and *Gozdarski vestnik*), which published several articles. One article was also published in *Geografski vestnik* (Šmid Hribar, Bole, and Urbanc 2015) and one in *Acta geographica Slovenica* (Ribeiro and Šmid Hribar 2019).

In terms of the level to which ES were addressed, we noted that the first two studies (master's and bachelor's theses) had only a weak interaction with ES, i.e., they addressed them on a more general level. Following in 2010 and 2012, some studies (bachelor's theses and professional article) expressed a moderate interaction with ES (ES are part of the analysis, but have not been assessed yet). The first study that expresses a strong interaction with ES and provides a quantitative assessment of selected ES

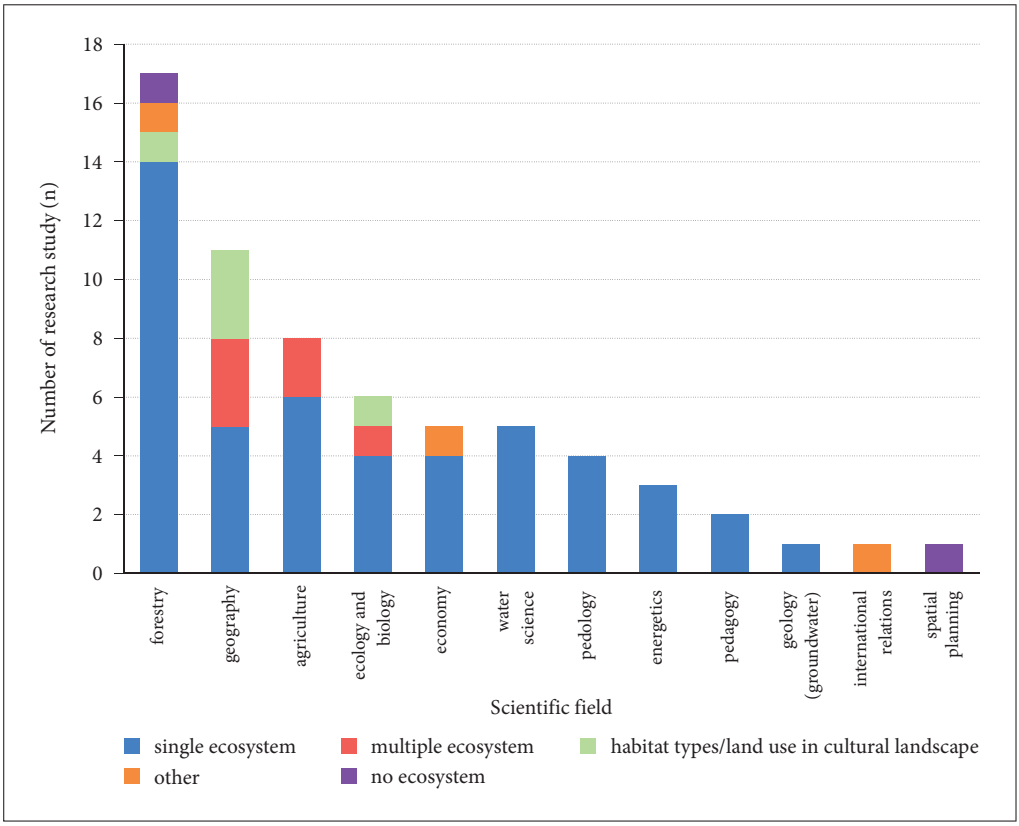
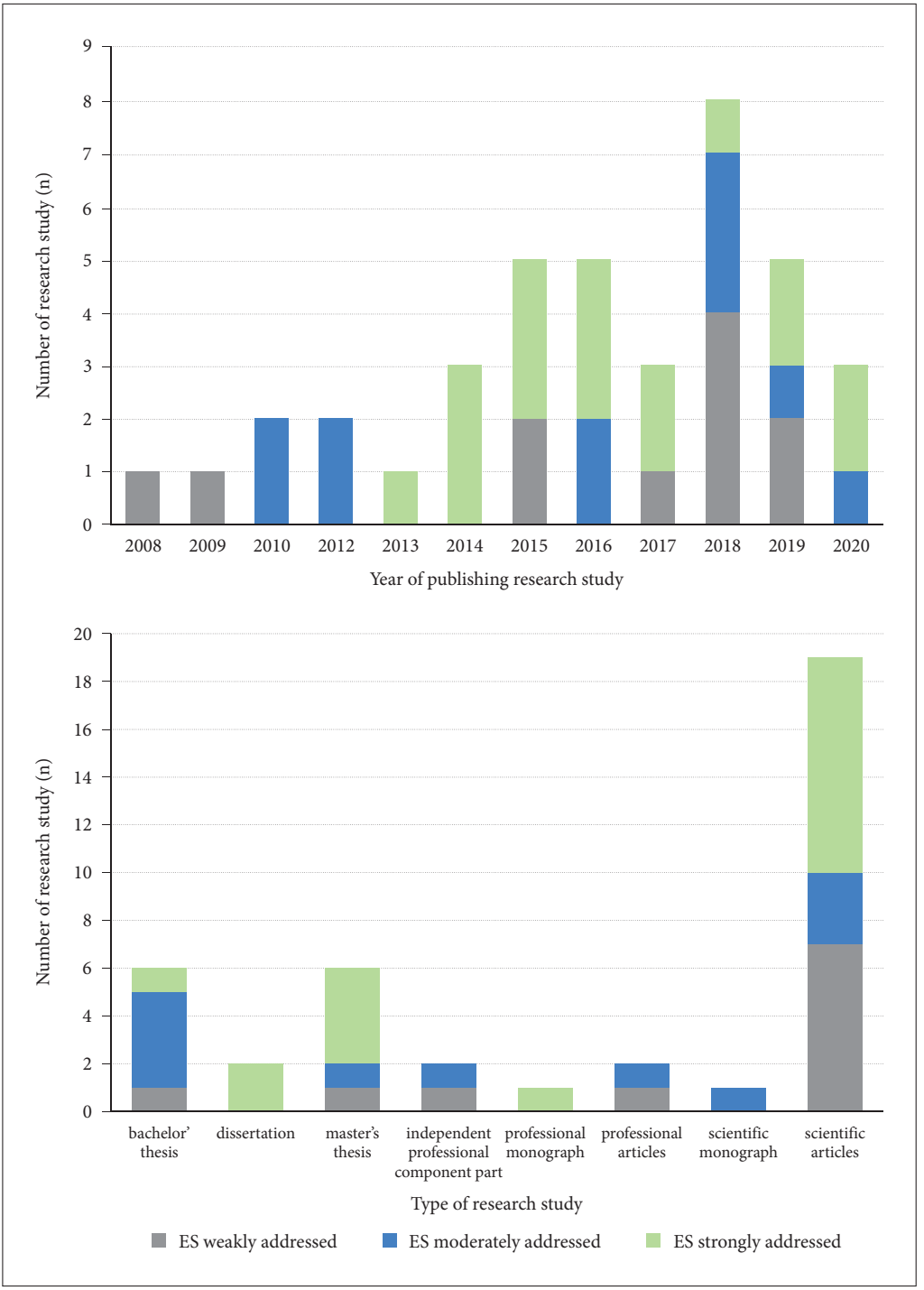


Figure 5: Scientific fields of the authors according to the diversity of the examined ecosystems.

Figure 6: Studies according to the level to which ES were addressed per the time frame and type of studies. ➤


Number of research study (n)
0
1
2
3
4
5
6
7
8
9
2008
2009
2010
2012
2013
2014
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2016
2017
2018
2019
2020
Year of publishing research study
Number of research study (n)
0
2
4
6
8
10
12
14
16
18
20
bachelor' thesis
dissertation
master's thesis
independent professional component part
professional monograph
professional articles
scientific monograph
scientific articles
Type of research study
ES weakly addressed
ES moderately addressed
ES strongly addressed

was published in 2013 in the field of forestry (Mavsar, Japelj, and Kovač 2013). From 2015 onward, at the height of studies being published, studies started appearing that have a weak interaction with ES. The majority of these studies are scientific articles (Figure 6, down). On the other hand, two thirds of the bachelor's theses express a moderate interaction with ES, while two thirds of the master's theses and both dissertations indicate a strong interaction.

The authors most often chose to do studies in the field of ES to 1) draw conclusions to help them make decisions when shaping strategies/policies, 2) determine the availability of ES, 3) raise awareness on the significance of ES, 4) verify the public's perception of ES, and 5) assess the effect of a particular practice on ES (Table 2). Other motives, such as studying payment options for ES, the need to develop a new method, integrating the concept of ES into another concept, and similar motives were less common and generally appeared in scientific articles. The diversity of the motives has grown over the years.

Table 2: The motives that drove authors to examine ES (n=62).

Motives	n	%
Foundation for paying for ES	2	3.2
Integrating the concept of ES into another concept	3	4.9
Raising awareness	11	17.7
Assessment of the effect of the practice on ES	7	11.3
Assessment of the availability of ES	12	19.4
Support with decision-making/forming strategies, policies	14	22.6
Assessment of the public's perception of ES	9	14.5
Developing a new method, indicator for assessing the availability of ES	2	3.2
Presenting the existing tools, methods, concepts in the field of ES	2	3.2

4.2 Detailed overview of the different aspects of ecosystem services

About two thirds of the studies (24; 61.5%) focused on one ecosystem. Six studies examined several ecosystems, for example Areh (2016) studying the forest and grassland ecosystem, Vurunić (2015) focusing on the agricultural, grassland, forest, and freshwater ecosystem. Five studied ES in a cultural landscape featuring different habitat types and land use (for example, Uršič 2012; Ribeiro and Šmid Hribar 2019). Two studies did not define the ecosystem and two studied nature areas under protection (Natura 2000, protected areas). In terms of the ecosystems, the majority featured the forest and woodland (24; 61.5%) (Figure 7). This was followed by agricultural land (including hedgerows), grassland and pastures, rivers and lakes, urban (and built) ecosystems, and wetlands. Only one study (Vurunić 2015) examined the ES of an ecosystem related to the sea (coastal type). Six studies addressed other ecosystems and/or areas (for example, nature areas under protection) that are not further specified or specific ecosystems in terms of land use in the cultural landscape that we could not place in any MAES category, such as tall-herb communities, channels etc. (Šmid Hribar 2014; Ribeiro and Šmid Hribar 2019).

Our study relied on the MEA classification (Millennium … 2005), although we were not able to determine which ES some of the studies were addressing. Using the MEA classification, we were able to classify ES in 25 studies, which are presented in more detail below. The analysis of the selected studies and their examined ES groups per the MEA classification and per individual ES revealed the most often addressed were regulating ES (90 out of 224 identified ES; 40.2%) (Figure 8). They were especially commonly represented in scientific articles as well as bachelor's and master's theses. They were followed by provisioning (56; 25.0%) and cultural ES (52; 23.2%). The least frequently studied were supporting ES (26; 11.6%).

The most commonly addressed individual ES is the cultural ES, i.e., recreation and ecotourism (18 studies), followed by the regulating ES natural hazard regulation and provisioning ES fiber with 16 studies each. Among the latter are wood as a material and as a fuel and other materials (for example, fodder, peat, production of energy and industrial crops). The most prominent regulating ES are climate regulation (carbon sequestration) (15 studies), water purification and waste treatment (14 studies), and water regulation (14 studies). As far as the provisioning ES, the prevailing categories were food (14 studies), agricultural products (10 studies), and drinking water (11 studies). In one case, the ES of biochemicals, natural medicines, and pharmaceutical were addressed; two studies addressed disease and pest control, knowledge, inspiration, social relations, photosynthesis, and the water cycle. The only ES from the MEA classification that was not studied in the selected studies was cultural diversity.

In terms of the supporting ES, soil formation and nutrient cycling were the most frequently addressed. The studies examined a few other ES, but we could not place them in the MEA classification (for example, well-being, contemplation area, abiotic heterogeneity, biotic water flow, water as an energy

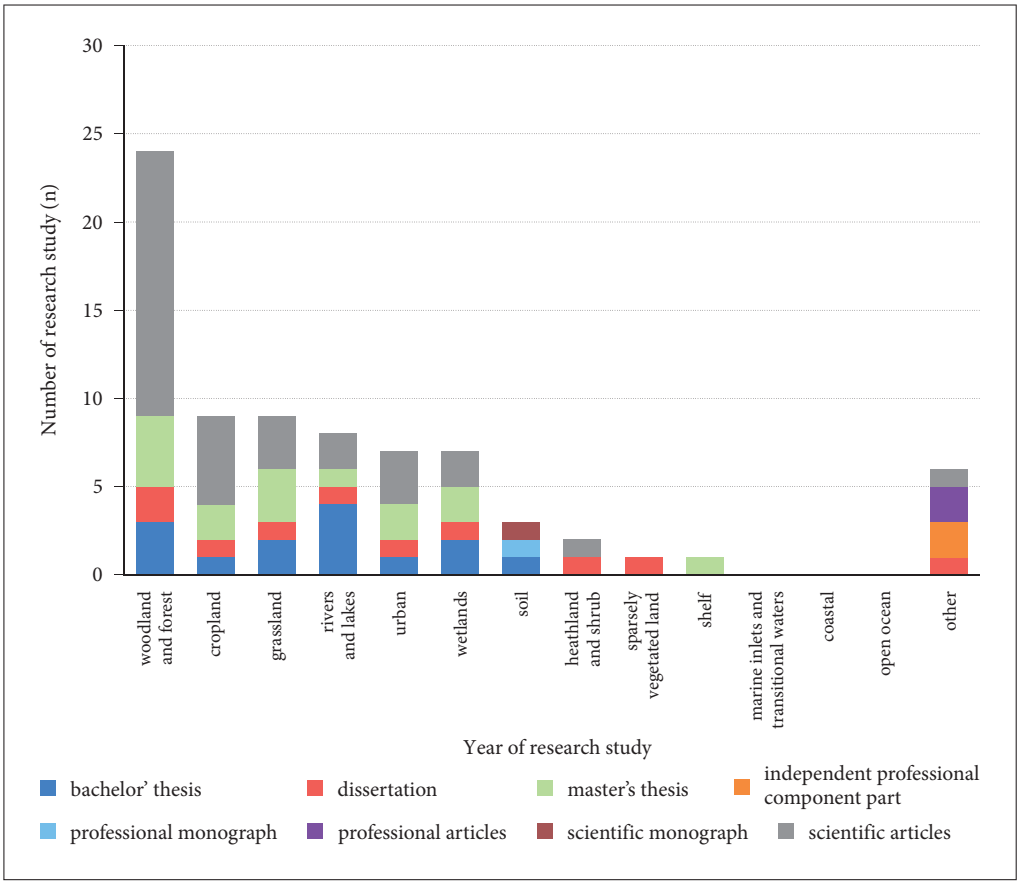
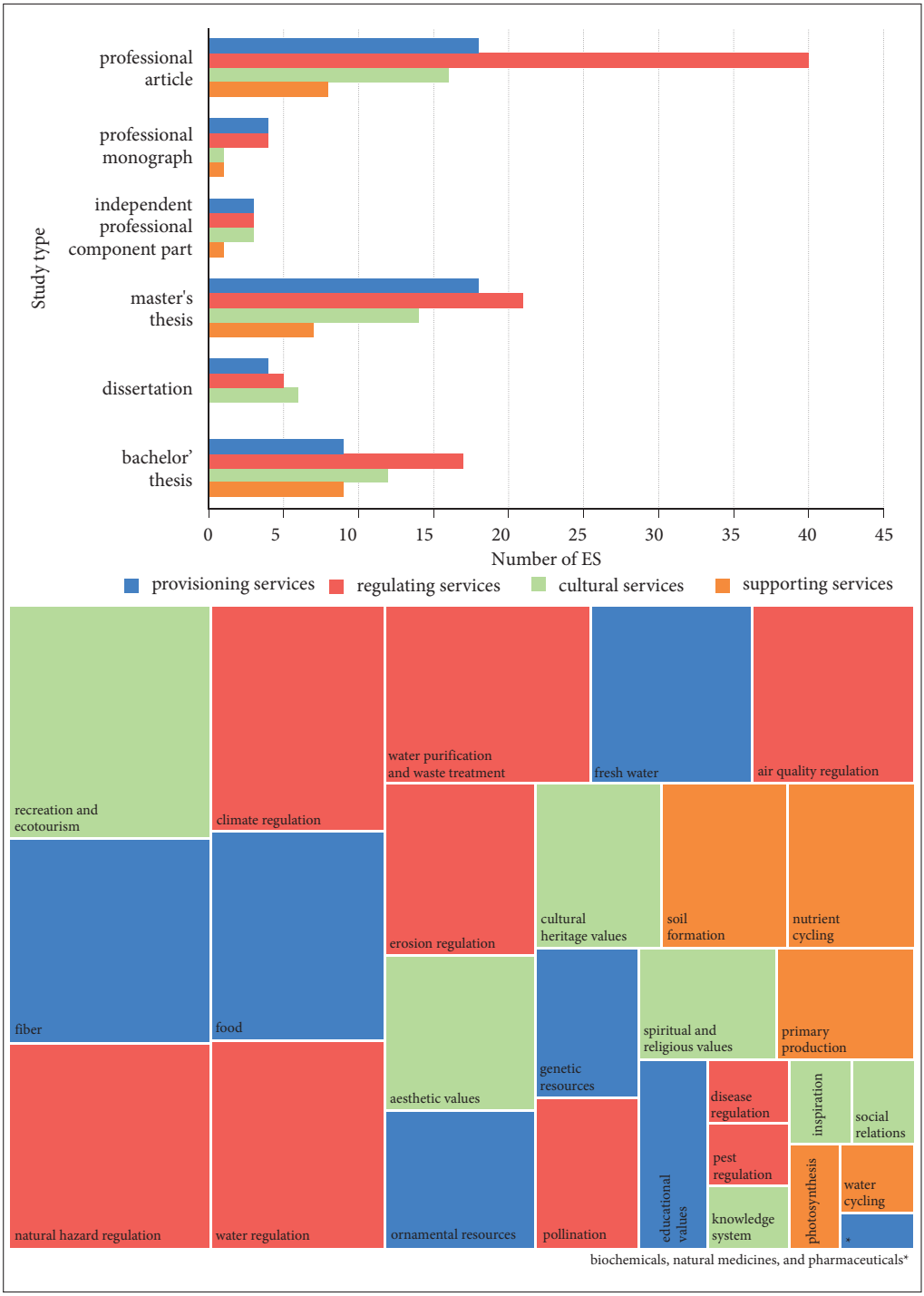


Figure 7: Studies examining ecosystems per the MAES typology and the type of study.

Figure 8: ES studies per the MEA classification and study type (up) and graphic depiction of the frequency of individual ES being addressed per the MEA classification (down) – the rectangle surface area is proportional to the share of all the studied ES (n=224). ➤ *p. 22*


professional article
professional monograph
independent professional component part
master's thesis
dissertation
bachelor' thesis
Study type
0
5
10
15
20
25
30
35
40
45
Number of ES
provisioning services
regulating services
cultural services
supporting services
recreation and ecotourism
climate regulation
water purification and waste treatment
fresh water
air quality regulation
fiber
food
erosion regulation
cultural heritage values
soil formation
nutrient cycling
aesthetic values
genetic resources
spiritual and religious values
primary production
natural hazard regulation
water regulation
ornamental resources
pollination
educational values
disease regulation
pest regulation
knowledge system
inspiration
social relations
photosynthesis
water cycling
*
biochemicals, natural medicines, and pharmaceuticals*

source). The majority of the studies (21; 84.0%) also included biodiversity, habitat/living environments, and natural heritage alongside ES.

The MAES group based their study of ES at the European level on the state of ecosystems and their ES (MAES 2011), so we carried out a detailed analysis to examine the connections between the studied ecosystems and ES. As many as 15 out of 17 studies examined the ES of the **forest ecosystem**, for which we recorded the biggest variety of ES. The most commonly addressed were raw materials (wood), recreation and ecotourism, climate regulation (carbon sequestration), and natural hazard regulation. Five studies examined the **grassland ecosystem**, while four studied **urban** (and built) and **agricultural ecosystems**. Provisioning ES, especially food and raw materials (wood) were the most studied in all the ecosystems. In terms of the regulating ES, the studies focused on climate regulation (carbon sequestration), while cultural ES focused on recreation, cultural diversity, and aesthetic values. Supporting ES were only studied in the forest ecosystem, most often involving soil formation (5 studies), the urban ecosystem, and soil. Biodiversity was also studied in all the ecosystems as an ES.

From among the possible methodological approaches to address ES – the classification of 26 methods into 4 groups (biophysical, socio-cultural, monetary, and integrative methods) was based on Harrison et al. (2018) –, the most commonly (27; 69.2%) utilized was narrative analysis (Figure 9). This method is used to address ES, predominantly with a qualitative description of either the state of ES (Zupanc, Pintar, and Podgornik 2018), the relevant legislation (Muršič 2019; Vuletič et al. 2020), or the relationships between the stakeholders (Nichiforel et al. 2018). This also includes literature overviews and past research overviews, usually to establish the context of the study, or to analyse the results of other studies in order to validate the research findings. The methods of preference assessment (8; 20.5.%) (Torkar, Verlič and Vilhar 2014; Ranacher et al. 2017) and of expert opinion (7; 17.9%) (Peters et al. 2015; Ribeiro and Šmid Hribar 2019) were used less often – in about a fifth of the studies. The preference assessment method

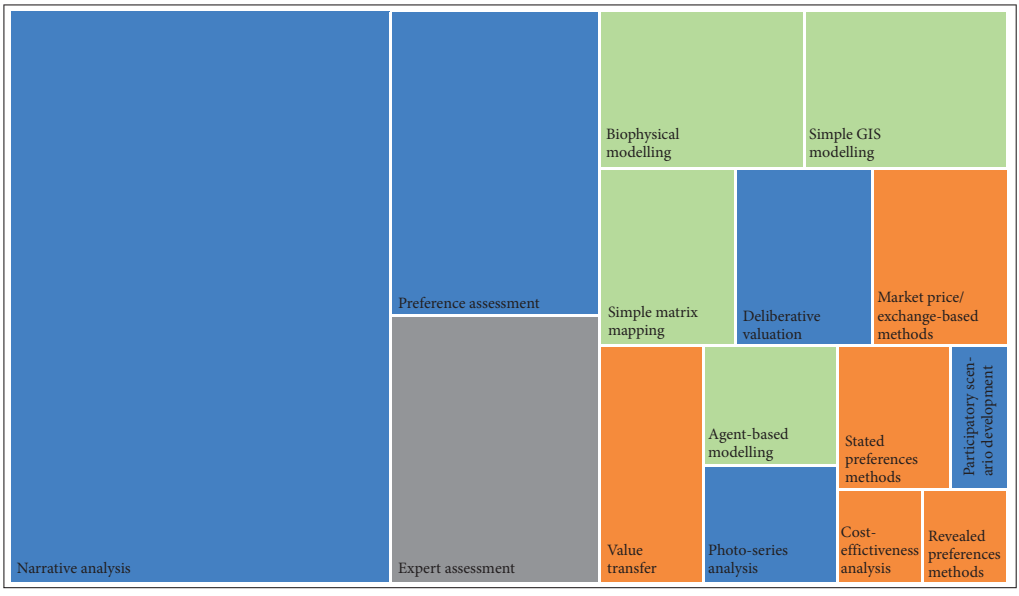


Figure 9: Graphic depiction of the frequency of different methods being used to address ES; the surface area of the square is proportionate to the share of the studies (n=39) in which an individual method was used. The dark blue colour represents socio-cultural methods, the green stands for biophysical methods, the yellow for the methods of monetary valuation, and the grey for the approach of the expert assessment/evaluation.

involves different ways of collecting data about an individual's wishes, needs, constraints etc. regarding the different aspects of addressing ES. None of the studies used any forms of economic values, but the preferences were expressed through ranking, assessment, distribution, and paired comparisons. This was most often done with questionnaires, focus groups, and interviews. The method of expert opinion was placed into a special group of methodological approaches, where someone with expert knowledge determines the analysed aspects of ES, which suffices for a consistent assessment. Despite the fact that this approach can be very biased as well as unverifiable, it is quite often utilized. Biophysical modelling was used in a tenth of the studies (4; 10.3%) (Rudolf 2008; Železnikar 2015; Costantini et al. 2018), as was the approach with GIS modelling (Grilli et al. 2017; Ribeiro and Šmid Hribar 2019; Vilhar and Kozamernik 2020). The former is a quantitative analysis of biophysical factors that can impact the state of ES; in practice, this kind of analysis is carried out using various ecological and hydrological models, soil erosion models, and similar. GIS modelling usually includes the use of spatial data, merging them and creating synthesized indicators that can be used to assess the state or predict the future development of ES. The other methodological approaches were used in fewer than 10% of the studies.

An individual study can also merge or combine different methodological approaches. 5 studies (12.8%) used methods from two different method groups and another 5 studies used methods from as many as three different groups. Figure 10 depicts how often methodological approaches within four aggregated groups of methodological approaches were used in the same study. Three studies (Peters et al. 2015; Costantini et al. 2018; Vrščaj 2018) used the methods from the group of socio-cultural and other methodological approaches and one study used methods from the group of socio-cultural and monetary methods (Japelj 2016) or the group from biophysical and monetary methods (Areh 2016).

Three studies used methods from all three groups concurrently, i.e., from the group of socio-cultural, biophysical, and other methods (Šmid Hribar 2014; Železnikar 2015; Ribeiro and Šmid Hribar 2019). One study (Grilli et al. 2017) used the methods from the socio-cultural, monetary, and biophysical method groups in a single study, while another (Vurunić 2015) used methods from socio-cultural, monetary, and other method groups. With the exception of the study by Grilli et al. (2017), which focuses

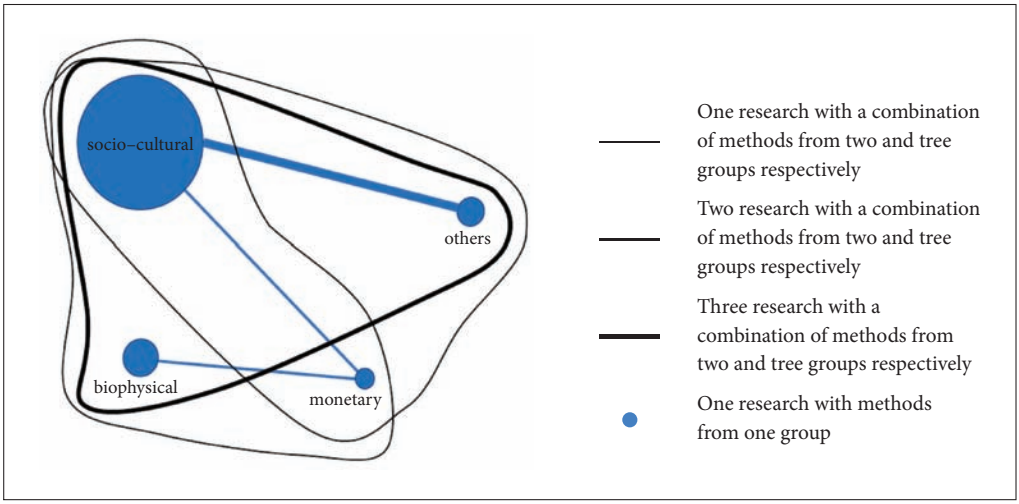


Figure 10: Frequency of using methods to address ES divided into four groups (socio-cultural, biophysical, monetary, others). The size of the circle represents the number of studies where methods from a certain group were used, while the thickness of the line represents the number of studies that used methods from two different groups and the thickness of the polygon borders represents the number of studies that used methods from three groups.

on forests, the common feature of these studies is that they analyse several different ecosystem types at once. A diversity of examined ecosystems usually also involves a multiple of ES, which consequently requires several different methodological approaches being implemented.

Not only does analysing several ecosystems at once require multiple methodological approaches, but some individual ecosystems provide several ES at the same time, which also results in a greater methodological diversity. Figure 11 illustrates the relative frequency of the use of different methods in relation to the ecosystems that were analysed in the studies. As mentioned, socio-cultural methods dominate in the majority of cases, while it is also clear that the diversity of the methodological approach is the greatest when grassland and pastures, forests, and wetlands are examined. A somewhat lesser variety of methodological approaches was noted in ES studies ES soil and ES coastal ecosystem types.

An overview of the interconnection between the examined ES and the methodological approaches (Figure 12) indicates that this connection is quite homogenous, i.e., that the prevailing choice when assessing ES from the group of provisioning, regulating, and cultural ES are socio-cultural methods, followed by about the same shares of biophysical and other types of methods; the least commonly used were monetary methods. The latter were never used to address any of the supporting ES in the analysed studies.

Most of the studies analysed ES at the local (11; 28.2%), regional (9; 23.1%), and national (11; 28.2%) spatial levels. Only 4 studies were expanded to the international level, while a further 4 did not have a defined spatial level (for example, Žujo and Danev 2010, which examines ES from the methodological aspect). An overview of the ecosystems according to their spatial levels indicates that forest was

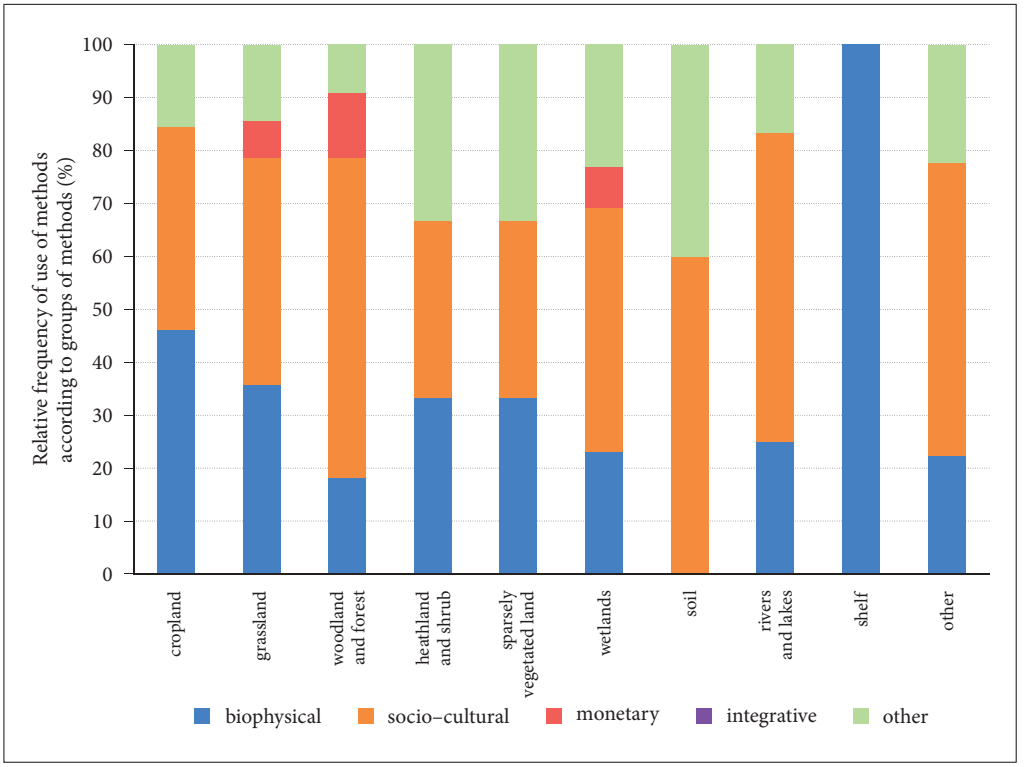


Figure 11: Relative frequency of using different methods in ES studies according to the analysed ecosystem types.

most often analysed at the national level, while agricultural areas, wetlands, urban (and built) ecosystems, meadows and pastures, rivers and lakes were analysed at the local level. In terms of groups, biophysical methods were used only at the local and regional level, monetary methods were used at the local, regional, and national level, while socio-cultural methods, with the prevailing methods being narrative analysis and preference analysis, were used on all spatial levels.

Authors most often studied ES in Slovenia in protected areas, water surfaces (river basins, ponds, lake), or within administrative units (municipalities, statistical region, regional units of the Slovenia Forest Service), which differ significantly in size between one another (Figure 13).

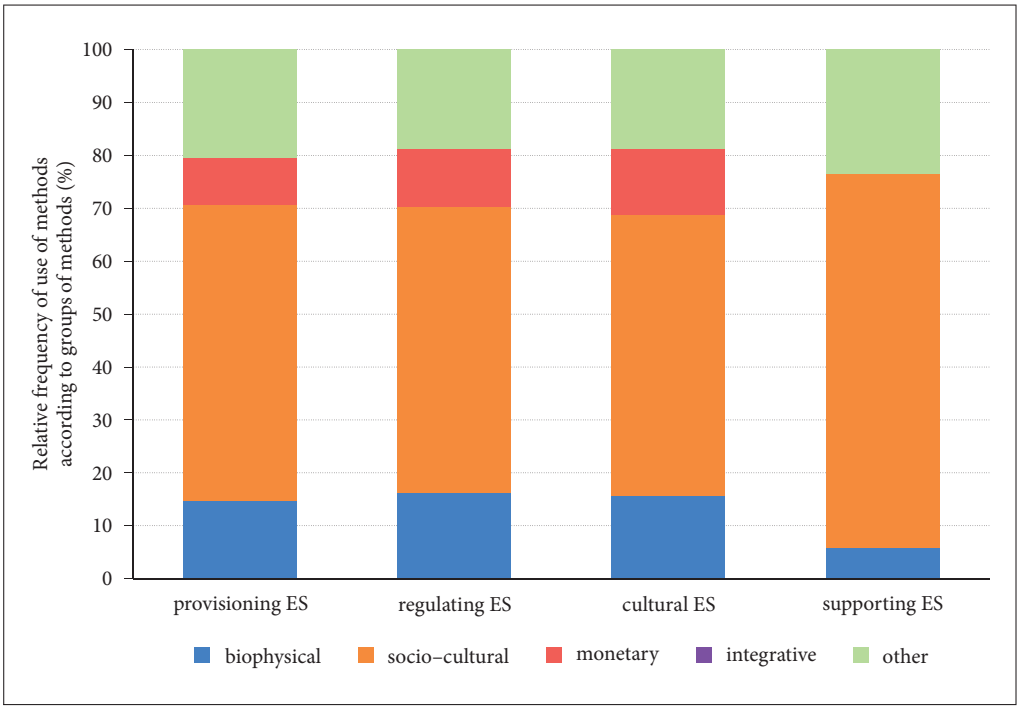
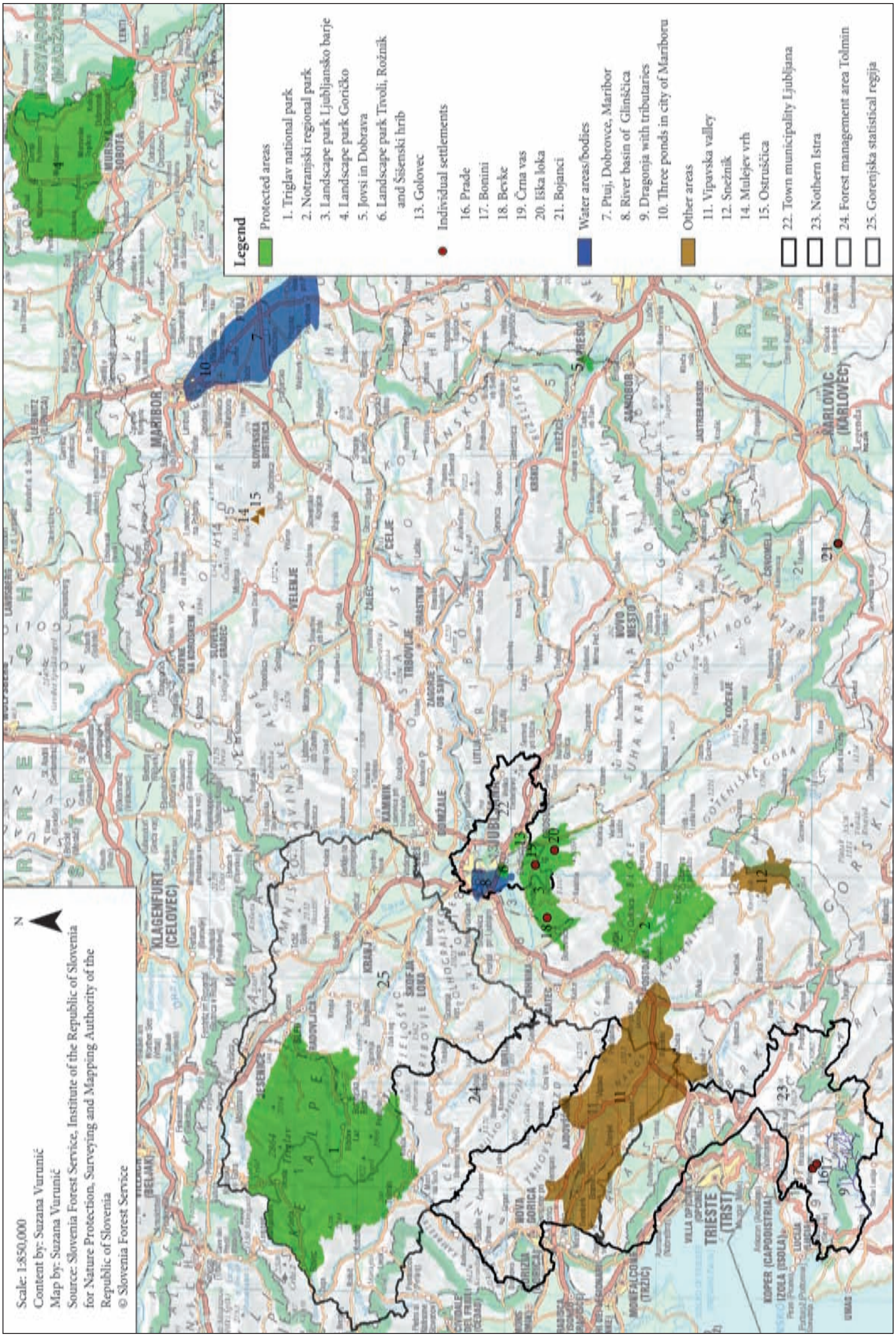


Figure 12: Relative frequency of different methods in ES studies according to the groups of addressed ES.

5 Discussion

Despite the small sample limiting the reliability of the conclusions, the dynamics of the ES studies in Slovenia indicate an increasing trend in the number of studies and consequent deepening of this research area. This was evident especially in terms of scientific articles, less so for bachelor's and master's theses and dissertations, as no studies of this type have been recorded after 2018. Other studies have noted similar trends (Kull et al. 2015; McDonough et al. 2017; Xie et al. 2020). At the global level, the number of studies has been noticeably growing since 2014. The increasing number of published ES studies has undoubtedly been facilitated by new international magazines, such as *Ecosystem Services*, first published in 2012 and now featuring over 1000 scientific articles, though none were included in our selection. The fact that the first detailed study in Slovenia was only carried out in 2013 shows that the concept

Figure 13: A map of the pilot areas of ES studies in Slovenia. ►


Scale: 1:850,000
Content by: Suzana Vurunić
Map by: Suzana Vurunić
Source: Slovenia Forest Service, Institute of the Republic of Slovenia for Nature Protection, Surveying and Mapping Authority of the Republic of Slovenia
© Slovenia Forest Service
Legend
Protected areas
1. Triglav national park
2. Notranjski regional park
3. Landscape park Ljubljansko barje
4. Landscape park Goričko
5. Jovsi in Dobrava
6. Landscape park Tivoli, Rožnik and Šišenski hrib
13. Golovec
Individual settlements
16. Prade
17. Bonini
18. Bevke
19. Črna vas
20. Iška loka
21. Bojanci
Water areas/bodies
7. Ptuj, Dobrovce, Maribor
8. River basin of Glinščica
9. Dragonja with tributaries
10. Three ponds in city of Mariboru
Other areas
11. Vipavska valley
12. Snežnik
14. Mulejev vrh
15. Ostruščica
22. Town municipality Ljubljana
23. Nothern Istra
24. Forest management area Tolmin
25. Gorenjska statistical regija

of ES was slow to be recognized in Slovenia. On the other hand, newer studies were not necessarily more detailed, to the contrary. We were surprized by the renewed uptick of studies, especially scientific articles that express a weak interaction with ES. This means that the share of studied focusing primarily on ES is decreasing and the number of studies addressing ES as an amendment to enhance their draw is increasing. One of the goals Slovenia set in its National Environment Protection Programme … (Resolucija … 2020) in the area of preserving biodiversity and valuable natural features from 2022 onward included mapping and assessing ecosystem services and including their value in preparing and passing developmental, spatial, and other strategic or operative documents (goal 1/8, measure no. 44), which will require more detailed and comprehensive ES studies in the future to meet the goal.

Initially, the main goals of the studies were raising awareness about the importance of ES and the assessment of the availability; in recent years though, the studies are more often carried out to gain data that aids informed decision-making and shaping strategies and policies, assessing the impact of a certain practice on ES, and to evaluate the public's perception of individual ES. These methods were the most prevalent driving force of detailed ES studies. The overview of the studies also confirmed that the concept of ES is complex and often requires researchers from different scientific fields. Some articles in our research include as many as five different fields (for example, Keesstra et al. 2018; Báliková et al. 2019), in which forestry was the primary field and some of which may have been the result of EU projects, such as COST Actions.

Studies at the local, regional, and national spatial levels are relatively evenly represented. Unsurprisingly, the variety of the methods decreases with higher spatial levels, since studying ES requires good quality and reliable data, ample knowledge, and a sufficient timeframe. On the other hand, the most diverse motives for carrying out a study were incepted at the national level, where the more general motives, such as assessing the availability of ES and informing the public, were supplemented by looking for ways to integrate the concept of ES with other concepts (for an example of a forest ES and forest functions, see Bončina, Simončič, and Rosset 2019) and how to implement payments for ES, especially in the forest ecosystem, which offers the most diverse ES to different stakeholders (the owners and the general public).

5.1 Ecosystems, ecosystem services, and methods in the analysed studies

We have determined that authors coming from several different scientific fields tend to focus on one ecosystem when studying ES. The most commonly analysed ecosystem is the forest, which is unsurprising, as most of the studies deal with forestry. Such a large share of studies in the field of forestry most likely stems from the fact that Slovenian forestry has been implementing a conceptually similar system of forest functions for at least a few decades and the idea of ES therefore does not constitute a breakthrough in the prevailing idea of multipurpose and sustainable forest management. On the other hand, geographers generally study the cultural landscape, whose intertwinement of various ecosystems make it multipurpose in nature (usually fields, grassland, orchards, hedgerows, and forest), therefore encompassing all the main ES groups (provisioning, regulating, cultural, and supporting). In said cases, the studies most often involve ES assessments based on existing matrixes that are more or less adapted to a specific area. The advantage of this kind of approach is its comprehensive and simultaneous analysis of multiple ES, which may be in conflict in a certain area and require a decision on which ecosystem to prioritize (trade-offs; for example, should the focus be on preserving a wet meadow or cultivating a field there instead). Such an approach enables a dialogue between different stakeholders and looking for synergies to facilitate further development and area management.

There is an expressed lack of studies examining water ecosystems, especially marine ecosystems. Even though it is crucially important for the survival of mankind, the role of soil formation in ensuring ES has also not been recognized yet. Water and soil are being ever more ardently emphasized as the strategic assets of the 21st century; the former in the light of water areas being privatized and inap-

propriate interventions in waterside areas occurring, while the latter is facing problems like land degradation, building on fertile land, and pollution, all of which will require studies of the ES that these two assets provide.

In terms of the individual ES, the most prevalent ones in our analysis were recreation and ecotourism, natural hazard regulation, and material resources, which provide sufficient data and methods to be assessed. On the other hand, the most commonly studied ES groups were regulating ES and not provisioning or cultural, despite the fact that regulating ES usually require more advanced and complex methodological approaches. It seems that studies in Slovenia follow the basic principle of ES, which is supporting the sustainable use of natural resources. Furthermore, most of the analysed studies emphasize biodiversity as one of the ES or nature areas under protection. However, we have also determined that none of the studies used the CICES classification (Common … 2018) to divide and outline the indicators for studying ES, even though it was developed specifically to enable a more detailed and comprehensive analysis of ES. It is also evident that we still have not grasped exactly where to place biodiversity: is it a separate ES or just the foundation for the functioning of ecosystems and must not be regarded as independent, as the latest CICES classification (Common … 2018) instructs?

In terms of the share of different methods used to examine ES, a surprizing share of the studies that were published in articles used the expert assessment (7; 17.9%). This approach, in which a group of authors assess the ES based on their own judgement and previous knowledge of the issue, can be quite risky, as its reliability cannot be tested. This point was also raised by Seppelt et al. (2011), claiming that different methodological approaches should not be regarded as equal and that the reliability of the results must be critically evaluated. It should be noted that this approach was used in conjunction with other methods in all the examined studies. Our analysis of the studies that used several methods showed that the use of the expert assessment method usually occurs in cases that examine several ecosystems or several ES concurrently. We detected a correlation between the diversity of the analysed ecosystems and the methodological approaches, but this finding should be interpreted with pause, as Kopperoinen, Varumo, and Maes (2018) stress that the same methods can be used in different analytical contexts.

6 Conclusions

In 2005, the United Nations published the MEA Report in order to raise awareness among the research community and the general public about ecosystems deteriorating and being destroyed at the global level and the consequence of this for human life. In their message, the UN urged suitable measures being passed to improve ecosystem management. Since then, the field of ES analysis has developed in Slovenia, however, quite a few challenges remain for the concept to be applied comprehensively. We were surprized that the driving force of the studies was not nature conservation, nor was the concept adopted by nature conservationists. The presented overview has determined that the studies were carried out with the primary intent to assess the availability of ES and raise awareness about the significance of ES to aid in decision-making and shaping suitable strategies and policies. Our systematic mapping of the literature in the Scopus, Wos, and Cobiss databases yielded 39 studies (25 scientific and professional articles and monographs and 14 bachelor's and master's theses and dissertations) that were published in Slovenia from January 2005 to 21 August 2020 in which the authors examined ES. The key findings are presented below.

First, the number of studies is increasing, which indicates a growing interest in ES. An overview of additional search hits that were not included in the bibliographic databases would return an even larger number. However, while the minority of the analysed studies deal with the economic evaluation, mapping, and assessment of ES, our analysis did not detect any development scenarios, implementing measures based on an ES analysis, payments for ES (PES), and similar outcomes. What is more, the analysis indicates that the share of studies with detailed analyses of ES is decreasing.

Second, the first author in over two thirds of the studies operates in the field of natural sciences, predominantly forestry; the most commonly examined ecosystem is therefore understandably the forest. Of the social sciences, geography is the most prevalent, along with studying a multitude of ecosystems, sometimes the entire land use in a particular cultural landscape. These are also the two main approaches to studying ES: either the availability of an individual ES within a single ecosystem at different spatial levels or the availability of a wide spectrum of all ES groups in a cultural landscape at the local level.

Third, the analysis of the selected 25 studies revealed that addressing regulating ES is by far the most predominant, while supporting ES are the least examined. The most commonly examined individual ES is the cultural ES, namely recreation and ecotourism. This is followed by regulating ES moderation of extreme events and provisioning ES raw materials (especially wood).

Fourth, narrative analysis is by far the most prevalent methodological approach; it was used in two thirds of the studies, because it enables both a qualitative and quantitative examination of ES. This is most likely because the method can be applied to a wide array of data formats with differing reliability levels, as is characteristic of areas in the initial phases of research when systematically collected databases are not yet available. Other commonly used methods were (non-economic) preference evaluation using ranking, assessing, arranging, expert assessment, and biophysical and GIS modelling.

The results show that a more comprehensive and detailed examination of ES is required. We encourage the creation of a concise, but clear strategy about how Slovenia could benefit from including the concept of ES, for which stakeholders, with what purpose, and at what spatial levels. It is expected that conflicts regarding natural resource use will increase in the future, especially in more densely settled areas, and these data and tools will be needed to evaluate the various benefits and priorities. Studies on ES (assessment of their availability and benefits) at different spatial levels will be crucial for such assessments and will help decision-makers form concrete measures to improve natural resource management. Future Slovenian research of ES would do well to consider which scientific areas complement each other and in which segments, as finding synergies and collaborating in science usually contributes to: 1) more complex studies that are able to illuminate even more, sometimes contrasting aspects, and 2) uncovering new methods and approaches contributed by various scientific fields, which can lead to more comprehensive and innovative solutions and new joint projects.

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Appendix 1: CODE BOOK for the review paper Systematic mapping of studies on ecosystem services in Slovenia.

1	INDICATORS FOR IDENTIFICATION		Categories/Description
1.1	Year of publication		*Indicate the year of publication of the study.*
1.2	Title of the study		*Provide the title of the study.*
1.3	Autorship and Disciplinary composition	Authro(s) (surname, name)	*Provide authors.*
		1.3a Authorship composition	*Choose appropriately:* 1. Slovenian 2. foreign 3. mixed
		1.3b Institution of the first author	*Provide institution of the first author.*
		1.3c Country of the first author	*Provide country of the first author.*
		1.3d Scientific field of the first author	1. natural science 2. social science 3. engineering and technology 4. interdisciplinary 5. non-academic
		1.3e Scientific field of (co)authors – details	*Choose appropriately:* 1. forestry 2. ecology and biology 3. geography 4. economy 5. energetics 6. agriculture 7. water sciences 8. pedagogy 9. pedology 10. geology (underground water) 11. international relations 12. spatial planning 99. In case that there are several scientific fields, all scientific fields are listed from the above list.
1.4	Type of study		*Choose appropriately:* 1. scientific articles 2. professional articles 3. independent scientific component part 4. independent professional component part 5. scientific monograph 6. professional monograph 7. bachelor' thesis 8. master's thesis 9. dissertation

1.5	Language		*Choose appropriately:* 1. Slovene 2. English
1.6	Journal in which the study was published		*Indicate the journal in which the study was published.*
1.7	Motives to examine ecosystem services		*Choose appropriately:* 1. foundation for paying for ES (PES) 2. integrating the concept of ES into another concept 3. raising awareness 4. assessment of the effect of the practice on ES 5. assessment of the availability of ES 6. support with decision-making/forming strategies, policies 7. assessment of the public's perception of ES 8. developing a new method, indicator for assessing the availability of ES 9. presenting the existing tools, methods, concepts in the field of ES
2	INDICATORS FOR ECOSYSTEM SERVICES		Categories/Description
2.1	Examined ecosystems	2.2a Diversity of examined ecosystems	*Choose appropriately:* 1. single ecosystem 2. multiple ecosystems 3. habitat types/land use in a cultural landscape 4. no ecosystem 5. other
		2.2b Examined ecosystems according to MAES typology	*Choose appropriately:* 1 urban 2 cropland 3 grassland and pastures 4 woodland and forest 5 heathland and shrub 6 sparsely vegetated land 7 wetlands 8 rivers and lakes 9 marine inlets and transitional waters 10 coastal 11 shelf 12 open ocean 13 soil 14 other
2.2	Examined ES according to MEA classification		ES1 Provisioning services Food ES1.1 – crops ES1.2 – livestock ES1.3 – capture fisheries

	ES1.4 – aquaculture ES1.5 – wild plants and animal producs Fiber ES1.6 – timber ES1.7 – other (cotton, hemp, silk) ES1.8 – wood fuel ES1.9 – genetic resources ES1.10 – biochemicals, natural medicines, and pharmaceuticals ES1.11 – ornamental resources ES1.12 – fresh water ES2 REGULATING SERVICES ES2.1 – air quality regulation Climate regulation (carbon sequestration) ES2.2 – global ES2.3 – regional/local ES2.4 – water regulation ES2.5 – erosion regulation ES2.6 – water purification and waste treatment ES2.7 – disease regulation ES2.8 – pest regulation ES2.9 – pollination ES2.10 – natural hazard regulation ES3 CULTURAL SERVICES ES3.1 – cultural diversity ES3.2 – spiritual and religious values ES3.3 – knowledge systems ES3.4 – educational values ES3.5 – inspiration ES3.6 – aesthetic values ES3.7 – social relations ES3.8 – sence of place ES3.9 – cultural heritage values ES3.10 – recreation and ecotourism ES4 SUPPORTING SERVICES ES4.1 – soil formation ES4.2 – photosynthesis ES4.3 – primary production ES4.4 – nutrient cycling ES4.5 – water cycling ES5 OTHER ES5.1 – Multiple ES ES5.2 – ES on general ES5.3 – other ES (list them)
2.3 Use of ES classification	*Choose appropriately:* Yes – indicate classification used (CICES, MEA, TEEB …) No

2.4	Level of ES addressed in the study	*Choose appropriately:* 1. weak (ES mentioned) 2. moderate (ES part of analysis but not evaluated) 3. strong (qualitative and quantitative ES assessment)
2.6	Methods for addressing ES	*Choose appropriately:* Biophysical methods 1. biophysical modelling 2. ecosystem services modelling 3. agent-based modelling 4. integrated assessment modelling 5. simple GIS modelling 6. simple matrix mapping 7. advanced matrix mapping Socio-cultural methods 8. deliberate mapping 9. participatory scenario development 10. narrative analysis 11. deliberative valuation 12. preference assessment 13. photo-series analysis 14. photo elicitation 15. time use studies Monetary methods 16. cost-effictiveness analysis 17. benefit-cost analysis 18. market price/exchange-based methods 19. revealed preferences methods 20. stated preferences methods 21. resource rent 22. simulated exchange 23. production/cost function 24. value transfer Integrative methods 25. bayesian belief networks 26. multi-criteria decision analysis Other methods 27. expert assessment
2.7	Spatial level	*Choose appropriately:* 1. local 2. regional 3. national 4. global
18	Specific location	*If known, indicate the name of the study area.*

SISTEMATIČNO KARTIRANJE RAZISKAV O EKOSISTEMSKIH STORITVAH V SLOVENIJI

1 Uvod

Ekosistemske storitve (v nadaljevanju: ES) so koristi, ki jih ljudje prejemajo od ekosistemov (MEA 2005) in se uveljavljajo kot eno ključnih orodij za presojo trajnosti rabe naravnih virov. Kot take postajajo nepogrešljiv element številnih sektorskih politik ter strateških pobud. Pojavljajo se predvsem v politikah Evropske unije (EU), povezanih z okoljem (Bouwma s sodelavci 2017), kot so strategije Zelena infrastruktura – izboljšanje evropskega naravnega kapitala (2013), Strategija EU za biotsko biotsko raznovrstnost do leta 2020 (2011), Nova gozdarska strategija EU (2013) in Uredba o preprečevanju in obvladovanju vnosa in širjenja invazivnih tujerodnih vrst (2014). Koncept je vključen tudi v novo Strategijo EU za biotsko raznovrstnost do leta 2030 (2020). Slovenska zakonodaja ES neposredno ne omenja, kot odgovor na vključevanje evropske okoljske politike pa so ES vključene v naslednje programske in strateške dokumente: Program razvoja podeželja Republike Slovenije za obdobje 2014–2020 (2015), Strategija razvoja Slovenije 2030 (2017), Program upravljanja območij Natura 2000 (2015) in Resolucija o Nacionalnem programu varstva okolja za obdobje 2020–2030 (2020).

Ena od ključnih podlag za uresničevanje politik je zanesljiva in vsebinsko ustrezna informacijska baza, ki omogoča vpogled v problematiko, ki jo s politiko rešujemo. V primeru ES so to podatkovne zbirke na različnih prostorskih ravneh, ki omogočajo ocene in spremljanje njihovega stanja ter priprave različnih upravljavskih scenarijev. Idealno take zbirke vključujejo biofizikalne in socio-ekonomske podatke, izvirajo pa lahko iz nacionalno vodenih registrov (na primer Statistični urad Republike Slovenije) ali pa so rezultat posamičnih raziskav. Pregled in analiza tovrstnih virov podatkov sta ključna faza zasnove in uresničevanja zgoraj omenjenih politik, a to v Sloveniji do zdaj še ni bilo narejeno. Predvidevamo, da je Slovenija precej na začetku razvojne poti pri rabi koncepta ES, kar kaže tudi nezavidljiva uvrstitev na barometru vključevanja koncepta ES v posameznih članicah EU (Kopperoinen, Varumo in Maes 2018). Sicer se je s podobnim delom že začela ukvarjati neformalna Skupina za obravnavo ekosistemskih storitev – SOES (BISE 2018) v okviru delavnic, ki jih organizira z namenom povezovanja strokovnjakov, ki se ukvarjajo z raziskovanjem ES v Sloveniji, vendar ne tako celostno kot v tej raziskavi. Namen tega članka je predstaviti obstoječe raziskave ES v Sloveniji, opredeliti njihove ključne lastnosti in identificirati vrzeli v znanju, ki jih je na tem področju potrebno v prihodnje odpraviti, da bi lahko začeli z vključevanjem koncepta ES v Sloveniji. Temeljna cilja raziskave sta: 1) podati splošni pregled raziskav (časovna dinamika raziskav med 2005 in 2020, tip in jezik raziskav, zastopanost znanstvenih področij, motivi za preučevanje ES) in 2) vsebinsko podrobneje analizirati izbrane raziskave (skupine in posamezne ES, ekosistemi, metode, prostorska raven).

2 Razvoj koncepta ekosistemskih storitev

V začetku 70. let prejšnjega stoletja je bil prvič uporabljen koncept naravnega kapitala (Schumacher 1973), ki je pojasnjeval, da naravni viri niso nujno neomejeni in da jih je treba za njihovo trajnostno uživanje bolj smotrno rabiti. Kmalu je več avtorjev začelo sistematično raziskovati problematiko netrajnostne rabe ter družbene blaginje, hkrati pa se je začelo razvijati strokovno izrazoslovje, na primer 'javne storitve globalnih ekosistemov' (Ehrlich, Ehrlich in Holdren 1977), 'storitve narave' (Westman 1977), uveljavil se je tudi pojem 'ekosistemske storitve', ki sta ga koncipirala in prvič uporabila Ehrlich in Ehrlich (1981). ES so bile vzpostavljene kot koncept, namenjen predvsem opozarjanju o negativnih vplivih

zmanjševanja biotske raznovrstnosti na delovanje ekosistemov ter prikazu povezav med blaginjo družbe in storitvami ekosistemov (Gómez-Baggethun s sodelavci 2010).

Ideja ES se je do 2020 razvila v konceptualni okvir, ki omogoča komunikacijo o raznolikih vidikih pomena ekosistemov za razvoj in obstoj družbe med različnimi deležniki (vladne službe, nevladne organizacije, zasebna podjetja) in sektorji (na primer gozdarstvo, kmetijstvo, ribištvo) (Barnaud in Antona 2014). Morda največji preboj na tem področju je dosegla Milenijska ocena ekosistemov (Millenium Ecosystem Assessment 2005; v nadaljevanju MEA), ki je eden najvidnejših prispevkov k prepoznavanju odvisnosti družbe od ES in delovanja ekosistemov na globalni ravni. Ključni konceptualni prispevki so še: raziskave o vključevanju vrednosti biotske raznovrstnosti in ekosistemskih storitev v vse ravni odločanja (*The Economics of Ecosystems and Biodiversity* … 2010; v nadaljevanju TEEB), okrepitev znanstveno-političnega panela o biotski raznovrstnosti in ekosistemskih storitvah (*Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services* 2015; v nadaljevanju IPBES) ter kartiranje in ocenjevanje ekosistemov ter njihovih storitev pri Evropski komisiji (*Mapping and Assessment of Ecosystem Services* 2011; v nadaljevanju MAES), kar je izvedla delovna skupina MAES.

Delovna skupina MAES je za preučevanje ES oblikovala 12 tipov ekosistemov (sedem kopenskih, enega sladkovodnega in štiri morske), kar omogoča strukturiran pristop k oceni stanja ekosistemov in identifikaciji ES (Mapping … 2011). Poleg tega so bile neodvisno od ekosistemov razvite tri mednarodno priznane klasifikacije ES: MEA (Millenium … 2005), TEEB (The Economics … 2010) in Skupna mednarodna klasifikacija ES (*Common International Classification of Ecosystem Services* 2018; v nadaljevanju CICES), ki se med seboj razlikujejo po načinu združevanja ES v nadrejene kategorije in po podrobnosti klasifikacije. MEA in TEEB delita ES v štiri skupine: oskrbovalne, uravnalne, kulturne in podporne ES. Klasifikacija CICES ločuje tri skupine ES: oskrbovalne, uravnalne/vzdrževalne in kulturne/socialne, vendar jih obravnava zelo sistematično in močno razdrobljeno. Poleg klasifikacij ES so ključni element raziskav tudi metode pri obravnavah ES, ki jih delimo v tri glavne skupine: 1) družboslovne metode, ki zajemajo analizo posameznikovih oziroma skupinskih preferenc in običajno obravnavajo koristi ES (Kelemen s sodelavci 2016; Harrison s sodelavci 2018); 2) metode ekonomskega vrednotenja, s katerimi običajno obravnavamo povpraševanja oziroma dejansko rabo ES in ki temeljijo bodisi na podatkih dejanskih tržnih menjav bodisi na modeliranju namišljenih trgov (Hanley, Shogren in White 2001; Christie s sodelavci 2008; Gómez-Baggethun s sodelavci 2010); 3) metode biofizikalnega vrednotenja ES, s katerimi najpogosteje ocenjujemo razpoložljivost ES (Vihervaara s sodelavci 2017).

Preučevanje ES se je sprva uveljavljalo zadržano, danes pa se področje hitro razvija. Pred desetimi leti so raziskovalci (Seppelt s sodelavci 2011) med izzivi raziskav s področja ES izpostavljali zelo splošne obravnave ES, uporabo manj celostnih pristopov (premalokrat upoštevane interakcije med ES) in celo pomanjkljivo poročanje o ključnih elementih raziskav. Novejše raziskave (Kull s sodelavci 2015; McDonough s sodelavci 2017; Xie s sodelavci 2020) ugotavljajo, da je še posebej od leta 2014 opaziti hitro rast raziskav na globalni ravni, predvsem v državah razvitega sveta (največ v ZDA), in da so glavni poudarki raziskav ES vplivi sprememb rabe tal, podnebnih sprememb in urbanizacije. Narejenih je bilo tudi nekaj pregledov raziskav.

Nedavno so de Groot, Brander in Solomonides (2020) objavili izjemno delo: dopolnili so zbirko raziskav ekonomskega vrednotenja ES, ki je nastala v okviru pobude TEEB; 267 raziskavam v zbirki so dodali 693 novih, kar pomeni prvo konkretno posodobitev po letu 2010. Vsako analizirano delo so opisali s 66 različnimi atributi in se osredotočili predvsem na pregled uporabljenih metod, načine standardizacije ekonomskih vrednosti, vidik prostorske ravni in časovne dimenzije raziskav vrednotenja. Campagne s sodelavci (2020) je pripravila pregled raziskav, temelječih na matriki ES, ki oceno ES povezuje z rabo tal. Ugotovili so, da se je pristop izkazal kot zelo uporaben, vendar pogrešajo jasno razlago uporabe te metode in lokalni kontekst, s katerim naj bi se v prihodnje nadgradile ocene ES. Rodela s sodelavci (2019) je pregledala raziskave, ki vključujejo preplet konceptov ES in skupnih virov. Oba koncepta

z različnih vidikov naslavljata upravljanje z naravnimi viri in bi s sinergijskim prepletom lahko prispevala k novim spoznanjem s tega področja (predvsem pri vlogi skupnosti in skupnostnih praks pri upravljanju z lokalnimi naravnimi viri).

Pričujoča raziskava je v marsičem drugačna od pravkar opisanih. Osredotoča se na teoretske ali praktične raziskave, ki temeljijo na podatkih, zbranih v Sloveniji. Hkrati so v raziskavo vključene tudi diplomske, magistrske in doktorske naloge, ne le članki iz mednarodno dostopnih zbirk raziskav. Poleg tega analiza bolj poglobljeno obravnava kombinacije različnih vidikov raziskav, kot so medsebojne odvisnosti vsebinskih poudarkov, metodoloških pristopov, prostorskih in časovnih okvirov.

3 Metode

Obravnave ES v Sloveniji smo se lotili s pregledom gradiva v slovenskem ali angleškem jeziku, v katerem so domači ali tuji avtorji preučevali ES v Sloveniji. Osredotočili smo se na znanstvena in strokovna dela iz bibliografskih baz, zavestno pa smo izpustili analize ES, objavljene v »sivi literaturi« (projektne študije, spletne strani). Pregled literature smo izvedli skladno s koraki za izvedbo metode sistematičnega kartiranja (angleško *systematic mapping*), ki izvira iz družboslovnih znanosti, a je prilagojena za preučevanje stanja na področju okolja (James, Randall in Haddaway 2016). V nasprotju od sistematičnega pregleda, ki skuša odgovoriti na specifično vprašanje, se sistematično kartiranje osredotoča na primerjanje, opisovanje in katalogiziranje razpoložljivih kazalnikov o določeni temi. V tem članku se kazalniki, ki smo jim dodali kode, nanašajo na izbrane objavljene raziskave. Sledili smo metodološkemu okviru s šestimi stopnjami in protokolu ROSES (***R**ep**O**rting Standards for **S**ystematic **E**vidence **S**yntheses in Environmental Research*; Haddaway s sodelavci 2017), s čimer je zagotovljena veljavnost in ponovljivost sistematičnega kartiranja (James, Randall in Haddaway 2016): 1) vzpostavitev skupine, opredelitev področja in kriterijev, testiranje in določitev protokola sistematičnega kartiranja, 2) iskanje raziskav, 3) presejanje raziskav, 4) kodiranje raziskav, 5) (opcijska) kritična ocena, 6) analiza ugotovitev.

3.1 Vzpostavitev skupine, opredelitev področja in kriterijev, testiranje in določitev protokola sistematičnega kartiranja

Kriteriji za izbor raziskav so bili: 1) recenzirane publikacije v bazah Scopus, Web of Science (v nadaljevanju: Wos) ali v slovenskem knjižničnem informacijskem sistemu Cobiss, 2) vnaprej pripravljen iskalni niz, 3) jezik gradiv (slovenski ali angleški), 4) tip gradiv (znanstveni in strokovni članki ter monografije, diplomska, magistrska in doktorska dela), 5) časovno obdobje (od januarja 2005 (leto objave poročila MEA (Millennium … 2005) do 21. avgusta 2020).

3.2 Iskanje raziskav

V omenjenih bazah smo gradivo iskali po iskalnem nizu (slika 1), sestavljenem iz naslednjih ključnih besed: '*ekosistemska storitev*', '*ekosistemske storitve*', '*ecosystem services*', '*ekosistemske funkcije*', '*ecosystem functions*', '*ekosistemske usluge*', '*koristi iz narave*' in '*benefits of nature*', pri čemur so se morali zadetki nanašati na Slovenijo. Omenjene ključne besede smo v bazah Scopus in Wos iskali v naslovu, povzetku, med ključnimi besedami, v bazi Cobiss tudi med predmetnimi oznakami, ki jih vpisujejo bibliotekarji. Iskanje je dalo 236 enot. Zadetke smo združili v skupno bazo in odstranili 55 podvojenih enot (podvajanje znotraj iste baze – na primer elektronski in pisni vir, podvajanje med bazami, podvajanje z isto raziskavo ter rezultati v primerih magistrskih in doktorskih del). Ena raziskava (Šmid Hribar 2014) je bila pozneje le delno objavljena v članku Ribeiro in Šmid Hribar (2019), zato smo vključili v izbor obe.

Iskalni niz v bazah Scopus in Wos

TITLE-ABS-KEY({ekosistemska storitev} OR {ekosistemske storitve} OR {ecosystem services} OR {ekosistemske funkcije} OR {ecosystem functions} OR {ekosistemske usluge} OR {koristi iz narave} OR {benefits of nature})
AND
TITLE-ABS-KEY({Slovenia} OR {Slovenija})

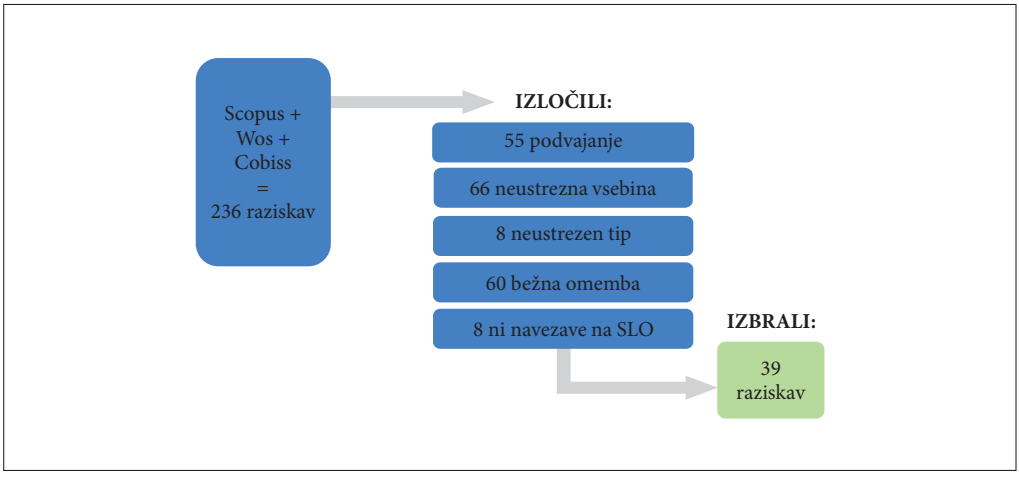
Iskalni niz v bazi Cobiss

(("ekosistemsk* storit*" OR "ecosystem services" OR "ekosistemsk* funkcij*" OR "ecosystem functions" OR "ekosistemsk* uslug*" OR "korist* iz narave" OR "benefits of nature")/TI,AB,SU,KW AND (Slovenij* OR Slovenia)/TI,AB,KW) AND PY=2005:2020 AND TD=(1.01 OR 1.02 OR 1.03 OR 1.04 OR 1.16 OR 1.17 OR 2.01 OR 2.02 OR 2.08 OR 2.09 OR 2.11)

Slika 1: Iskalni niz v bazah Scopus in Wos (zgoraj) ter v bazi Cobiss (spodaj).

3.3 Presejanje raziskav

V tej fazi, na začetku katere je bilo 181 enot, smo vsako enoto pregledali in dodatno presojali o ustreznosti vsebine. Da bi zajeli uporabo različnih sklonov, smo v iskalni niz v bazi Cobiss, ki smo ga izvedli v predhodni fazi, vključili iskanje z zvezdico (na primer *ekosistemsk**; slika 1). To pa ni bilo skladno z iskanjem po želeni besedni zvezi znotraj narekovajev, zato je prišlo med zadetki do šuma (tako je na primer Cobiss pokazal enote, ki so vsebovale bodisi besedo '*ekosistemska*' bodisi besedo '*storitev*'). Do podobnih težav je prihajalo tudi v bazi Wos. Zato smo odstranili 66 vsebinsko neustreznih enot. Zaradi neustreznega tipa gradiva (na primer prispevek na panelu) smo izločili 8 enot, 60 pa, ker so bile ES zgolj omenjene (samo v povzetku, uvodu ali zaključku). Dodatnih 8 enot smo izločili, ker je šlo za teoretsko gradivo, pri katerem so sodelovali avtorji iz Slovenije, vendar gradivo ni obravnavalo ES v Sloveniji (na primer Burkhard s sodelavci 2018). Postopek izbora v fazah 2 in 3 prikazuje slika 2.



Slika 2: Shema izbora ustreznih raziskav skladno z izločitvenimi kriteriji.

3.4 Kodiranje raziskav

Izbrane enote smo v nadaljevanju kodirali po vnaprej določenih kodah (priloga 1). Prvi sklop kazalnikov se je nanašal na splošne vsebine, kot je opredeljeno v prvem raziskovalnem cilju: 1.1) leto izida, 1.2) naslov članka, 1.3) avtorstvo in znanstveno področje, 1.4) tip gradiva, 1.5) jezik, 1.6) ime revije, v kateri je bilo gradivo objavljeno, 1.7) motivi za obravnavo ES, 1.8) stopnja obravnave ES (slika 3). Drugi sklop kazalnikov je bil vezan na ES in je naslavljal drugi raziskovalni cilj: 2.1) preučevani ekosistemi po tipologiji MAES (Mapping … 2011), 2.2) obravnavane ES po klasifikaciji MEA (Millennium … 2005), 2.3) uporaba klasifikacije ES, 2.4) metode obravnave ES, 2.5) prostorska raven obravnave ES in 2.6) morebitna konkretna pilotna območja. Oznake kod so predstavljene v prilogi 1: Kodirna knjiga. Raziskave smo kodirali v parih, po dva raziskovalca/raziskovalki skupaj. V primeru neujemanja smo vsi trije soavtorji članka poiskali skupni dogovor. V primeru, da je kateri od soavtorjev sodeloval pri posamezni raziskavi, sta to raziskavo kodirala ostala dva soavtorja.

3.5. Analiza ugotovitev

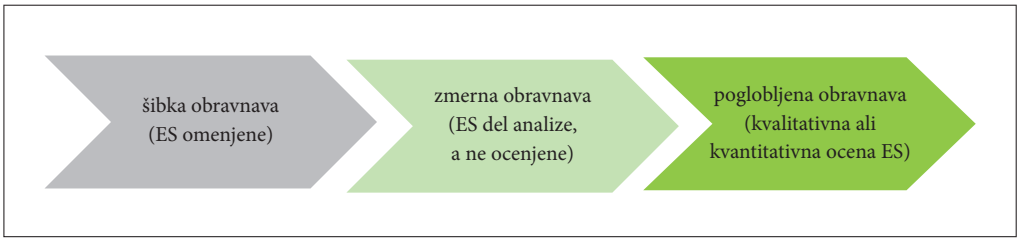
Dobljene rezultate smo strnili v ključne ugotovitve in jih s pomočjo tabelaričnih in grafičnih prikazov predstavili in opisali v poglavju 4.

4 Rezultati

4.1 Splošni pregled raziskav

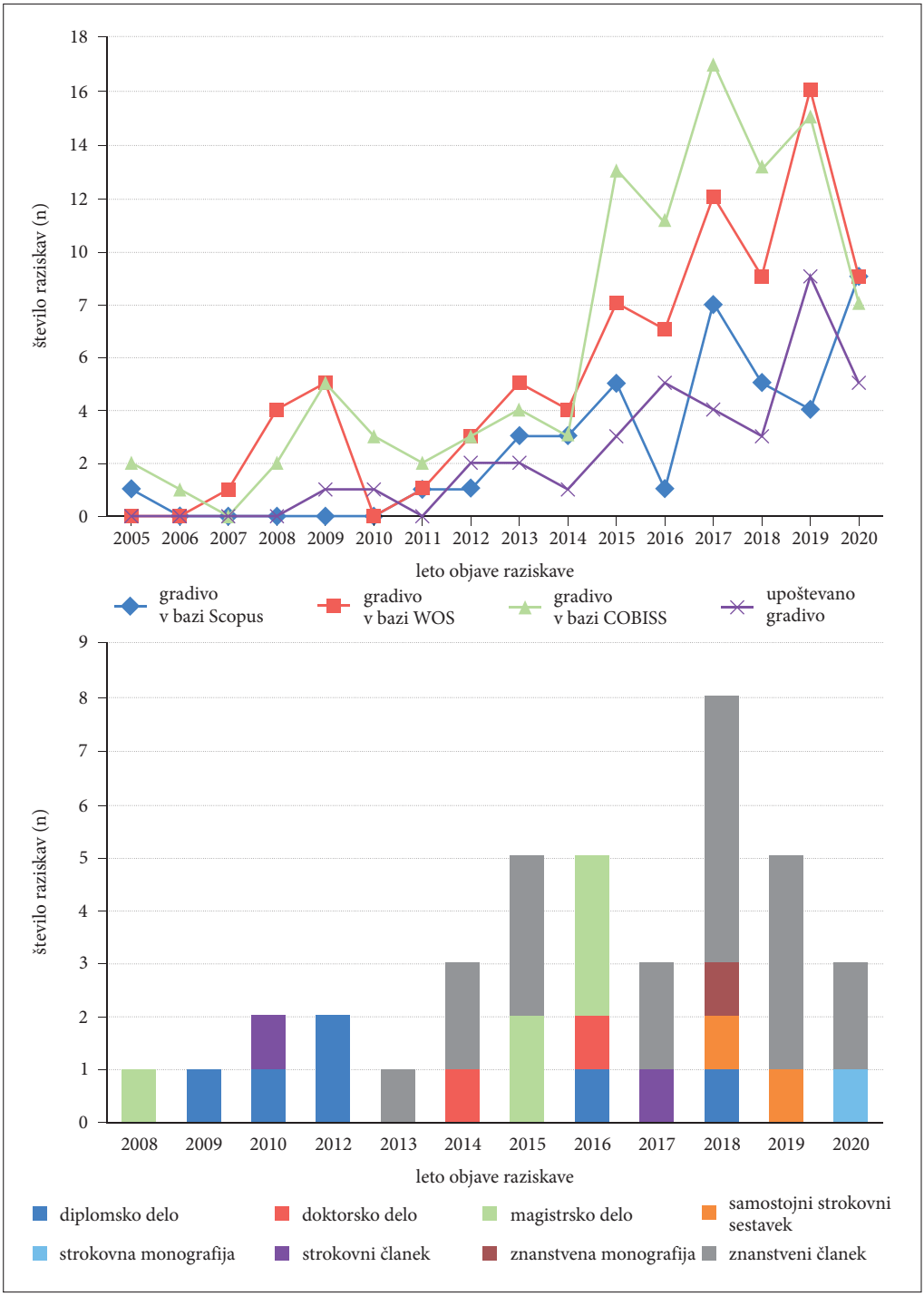
Vse tri baze (Scopus, Wos in Cobiss) so od januarja 2005 do 21. avgusta 2020 za iskalni niz, naveden v poglavju 3.2, dale skupno 236 raziskav. Po izvedbi presejalnega postopka, opisanega v poglavju 3.3, smo izbrali 39 ustreznih raziskav, ki obravnavajo ES v Sloveniji (slika 2).

Število raziskav v času narašča (slika 4, zgoraj; preglednica 1). Izrazitejši porast beležimo po letu 2015, višek je bil dosežen 2018. Med izbranimi raziskavami (n=39) je skoraj polovica znanstvenih člankov (19; 48,7 %), sledijo diplomska in magistrska dela (oboje po 6 raziskav; 15,4 %, skupno 30,8 %), po dva strokovna članka, samostojna strokovna sestavka in doktorski deli ter po ena znanstvena in strokovna monografija. Prvi raziskavi sta bili magistrsko (2008) in diplomsko delo (2010). Obe disertaciji in glavnina magistrskih del je bilo objavljenih v obdobju 2014–2016; po tem obdobju je bila najdena le še ena diplomska naloga. Znanstveni članki se začnejo pojavljati od 2013 naprej, monografiji šele od 2018 naprej (slika 4, spodaj).



Slika 3: Opredelitev stopnje obravnave ES v preučevanih raziskavah.

Slika 4: Število izbranih raziskav o ekosistemskih storitvah v Sloveniji od januarja 2005 do 21. avgusta 2020 v bazah Scopus, Wos in Cobiss ter število izbranih raziskav v istem časovnem obdobju (vijolčna črta) (zgoraj). Število raziskav v času po tipih raziskav (spodaj). ► *str. 44*


število raziskav (n)
leto objave raziskave
gradivo v bazi Scopus
gradivo v bazi WOS
gradivo v bazi COBISS
upoštevano gradivo
število raziskav (n)
leto objave raziskave
diplomsko delo
doktorsko delo
magistrsko delo
samostojni strokovni sestavek
strokovna monografija
strokovni članek
znanstvena monografija
znanstveni članek

Dobra polovica raziskav (20; 51,3 %) je napisanih v slovenščini, 19 (48,7 %) pa v angleščini. Med angleškimi močno prevladujejo znanstveni članki, samo eden je samostojni strokovni sestavek. Slabi dve tretjini raziskav (25; 64,1 %) so prispevali avtorji z enega znanstvenega področja, pri čemer se glavnina teh raziskav nanaša na diplomska, magistrska in doktorska dela. Štirinajst (35,9 %) raziskav je nastalo kot plod soavtorjev z multi- oziroma interdisciplinarnih področij, ki pokrivajo dve znanstveni področji ali več; v veliki meri gre za znanstvene članke (preglednica 1). Poleg tega je skoraj polovica člankov nastala v mednarodnem soavtorstvu.

Pri dveh tretjinah raziskav prihaja prvi avtor z naravoslovnega področja, znotraj katerega izstopa gozdarstvo; pri enajstih je prvi avtor s področja družboslovja, pri dveh pa tehničnih ved. Najpogosteje zastopano znanstveno področje vseh avtorjev analiziranih raziskav je gozdarstvo (26,6 %; n=64), sledita geografija (17,2 %) in kmetijstvo (12,5 %).

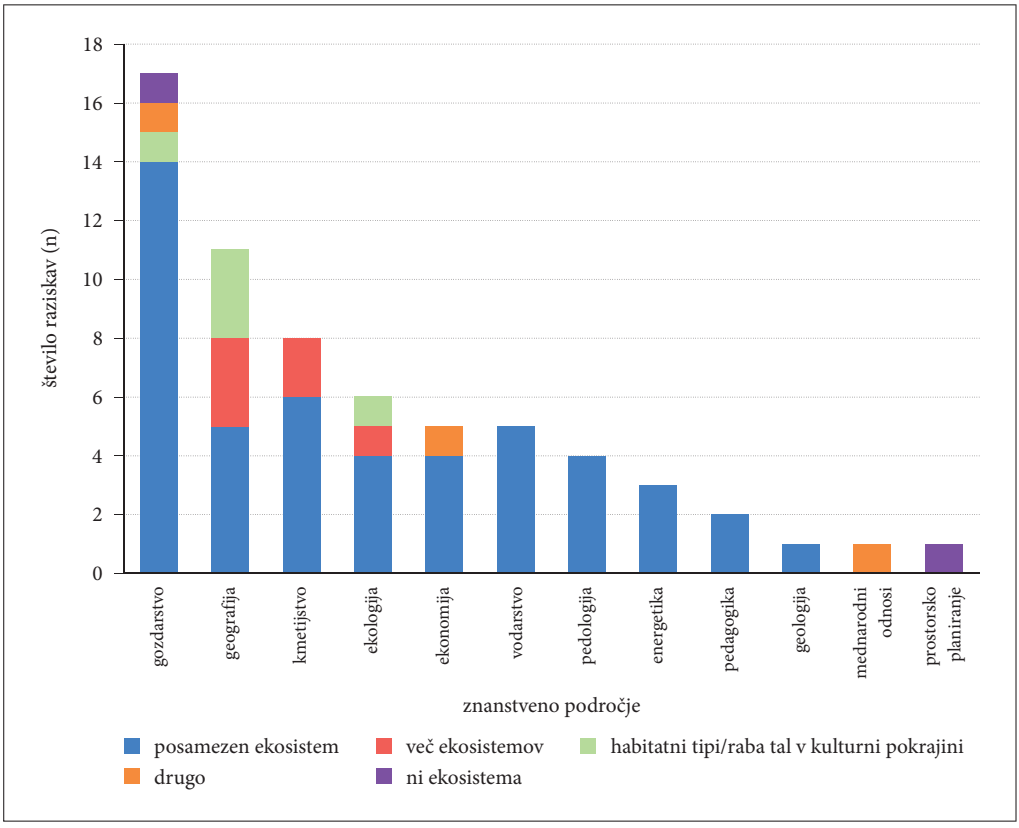
Preglednica 1: Splošne značilnosti obravnavanih raziskav (n=39).

spremenljivka	kategorija	število (n)	delež (%)
tip raziskav	znanstveni članki	19	48,7
	strokovni članki	2	5,1
	samostojni strokovni sestavek	2	5,1
	znanstvena monografija	1	2,6
	strokovna monografija	1	2,6
	doktorsko delo	2	5,1
	magistrsko delo	6	15,4
	diplomsko delo	6	15,4
jezik	slovenski	20	51,3
	angleški	19	48,7
znanstveno področje prvega avtorja	naravoslovje	26	66,7
	družboslovje	11	28,2
	tehnika	2	5,1
znanstvena področja avtorjev po člankih – podrobneje (n=64)	gozdarstvo	17	26,6
	ekologija in biologija	6	9,4
	kmetijstvo	8	12,5
	pedologija	4	6,3
	geologija (podzemne vode)	1	1,6
	energetika	3	4,7
	geografija	11	17,2
	ekonomija	5	7,8
	pedagogika	2	3,1
	prostorsko planiranje	1	1,6
	mednarodni odnosi	1	1,6
	vodarstvo	5	7,8
sestava soavtorstva	eno znanstveno področje	25	64,1
	multi- oziroma interdisciplinarno	14	35,9
stopnja obravnave	šibka	11	28,2
	zmerna	11	28,2
	poglobljena	17	43,6

Druga znanstvena področja (na primer ekologija in biologija, ekonomija, pedologija) so zastopana redkeje. Znotraj gozdarstva, geografije, kmetijstva in pedologije najdemo vsaj tri tipe raziskav ali več. Pregled znanstvenih področij z vidika raznolikosti obravnavanih ekosistemov pokaže, da so avtorji z različnih znanstvenih področij v veliki meri obravnavali po en posamezni ekosistem. Izjema so avtorji s področja geografije, kjer več kot polovica raziskav naslavlja več ekosistemov ali celotno kulturno pokrajino, kjer so prisotne različne rabe tal (slika 5).

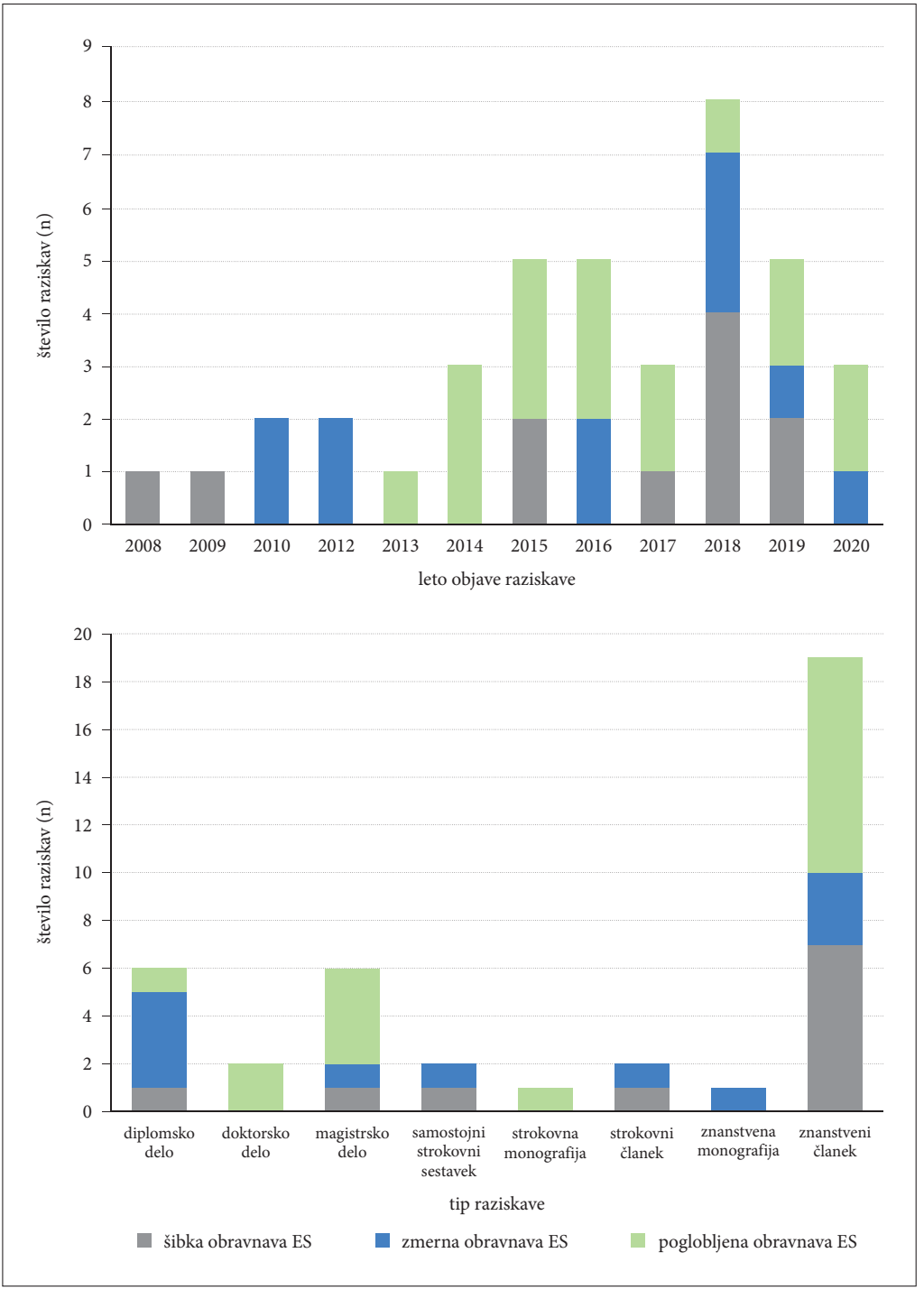
Znanstveni in strokovni članki so izšli v 17 različnih revijah, od katerih so zgolj tri domače, vse ostale so mednarodne. Večinoma so izšli članki vsak v drugi reviji, izjema so le revije s področja gozdarstva (*Forest*, *Forest Policy and Economics* in *Gozdarski vestnik*), v katerih je izšlo po več člankov. Po en članek je izšel tudi v *Geografskem vestniku* (Šmid Hribar, Bole in Urbanc 2015) in v reviji *Acta geographica Slovenica* (Ribeiro in Šmid Hribar 2019).

Z vidika stopnje obravnave ES opazimo, da sta prvi raziskavi (magistrsko in diplomsko delo) ES obravnavali šibko, torej na splošno. Že leta 2010 in 2012 dobimo raziskave (diplomska dela in strokovni članek), ki ES obravnavajo zmerno (ES so že del analize, niso pa še ocenjene). Prva raziskava, ki ES obravnava poglobljeno in izbrane ES kvantitativno oceni, se je pojavila na področju gozdarstva leta 2013 (Mavsar, Japelj in Kovač 2013). Od leta 2015 naprej, ko je izpričanih največ raziskav, so se zopet začele pojavljati nekatere, ki šibko obravnavajo ES. Največji delež takšnih raziskav je med znanstvenimi članki



Slika 5: Znanstvena področja avtorjev po raznolikosti obravnavanih ekosistemov.

Slika 6: Raziskave po stopnji obravnave ES v času in po tipih raziskav. ➤


število raziskav (n)
0
1
2
3
4
5
6
7
8
9
2008
2009
2010
2012
2013
2014
2015
2016
2017
2018
2019
2020
leto objave raziskave
število raziskav (n)
0
2
4
6
8
10
12
14
16
18
20
diplomsko delo
doktorsko delo
magistrsko delo
samostojni strokovni sestavek
strokovna monografija
strokovni članek
znanstvena monografija
znanstveni članek
tip raziskave
šibka obravnava ES
zmerna obravnava ES
poglobljena obravnava ES

(slika 6, spodaj). Po drugi strani dve tretjini diplomskih del ES obravnavajo zmerno, dve tretjini magistrskih del in obe doktorski deli pa poglobljeno.

Avtorji so se za raziskave s področja ES najpogosteje odločili iz naslednjih razlogov: 1) pridobitve spoznanj, ki bodo v pomoč pri podpori odločanju in oblikovanju strategij/politik, 2) da bi ugotovili razpoložljivost ES, 3) zaradi ozaveščanja o pomenu ES, 4) da bi preverili odnos javnosti do ES, 5) da bi ocenili vpliv posamezne prakse na ES (preglednica 2). Drugi motivi, kot na primer preučitev možnosti plačila za ES, potreba po razvoju nove metode, integracija koncepta ES z drugim konceptom in podobno, so bili manj izraziti ter so praviloma vezani na znanstvene članke. Z leti pestrost motivov narašča.

Preglednica 2: Motivi, ki so vodili avtorje raziskav k preučevanju ES (n=62).

motivi	število (n)	delež (%)
podlaga za plačilo ES	2	3,2
integracija koncepta ES z drugim konceptom	3	4,9
ozaveščanje	11	17,7
ocena vpliva prakse na ES	7	11,3
ocena razpoložljivosti ES	12	19,4
podpora odločanju/oblikovanje strategij, politik	14	22,6
ocena odnosa javnosti do ES	9	14,5
razvoj nove metode, kazalnika za ocenjevanje razpoložljivosti ES	2	3,2
predstavitev obstoječih orodij, metod, konceptov s področja ES	2	3,2

4.2 Podrobnejši pregled različnih vidikov ekosistemskih storitev

Slabi dve tretjini raziskav (24; 61,5 %) sta pri preučevanju ES izhajali iz enega ekosistema. Šest raziskav je obravnavalo več različnih ekosistemov, na primer Areh (2016) gozdni in travniški ekosistem, Vurunić (2015) kmetijski, travniški, gozdni in vodni ekosistem. Pet raziskav je preučevalo ES v kulturni pokrajini, kjer so prisotni različni habitatni tipi in rabe tal (na primer Uršič 2012; Ribeiro in Šmid Hribar 2019). Dve raziskavi nista definirali ekosistema in v dveh so preučevali varovana območja narave (Natura 2000, zavarovana območja). Med ekosistemi je največ raziskav obravnavalo gozd in ostala gozdna zemljišča (24; 61,5 %) (slika 7). Sledijo kmetijska zemljišča (vključujoč mejice), travniki in pašniki, reke in jezera, urbani (in grajeni) ekosistemi in mokrišča. ES v ekosistemu, vezanem na morje (priobalni tip), je preučevala zgolj ena raziskava (Vurunić 2015). Šest raziskav je obravnavalo še druge ekosisteme in/ali območja (na primer varovana območja narave), ki niso bila podrobneje opredeljena, in bolj specifične ekosisteme v okviru rabe tal v kulturni pokrajini, ki jih nismo mogli umestiti v kategorije MAES, kot so na primer steblikovje, kanali … (Šmid Hribar 2014; Ribeiro in Šmid Hribar 2019).

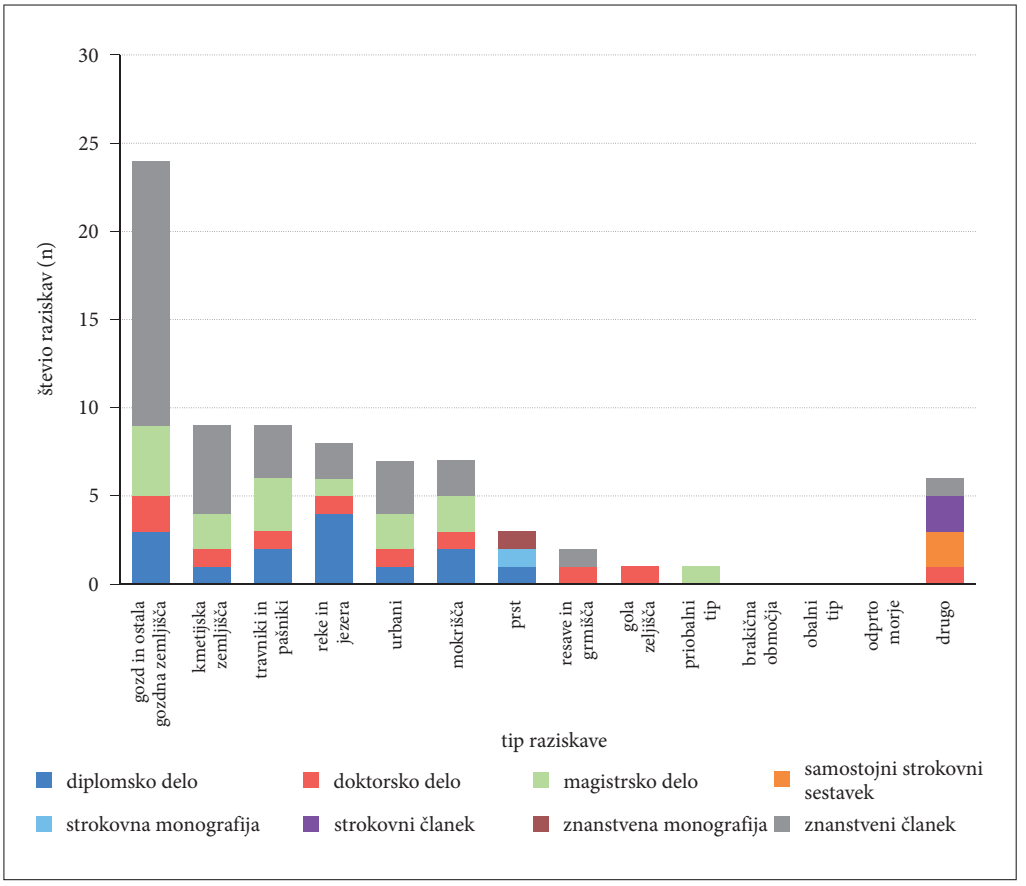
Pri obravnavi ES smo se oprli na klasifikacijo MEA (Millennium … 2005), vendar v nekaterih raziskavah ni bilo mogoče opredeliti, katere ES so bile predmet njihovega preučevanja. S klasifikacijo MEA smo uspeli razvrstiti ES v 25 raziskavah, ki jih v nadaljevanju podrobneje predstavljamo. Analiza izbranih raziskav in njihovih obravnavanih skupin ES po klasifikaciji MEA ter posameznih ES je pokazala, da so bile najpogosteje obravnavane uravnalne ES (90 od 224 identificiranih ES; 40,2 %) (slika 8). Izstopajo predvsem pri znanstvenih člankih ter pri diplomskih in magistrskih delih. Sledi preučevanje oskrbovalnih (56; 25,0 %) in kulturnih ES (52; 23,2 %). Najredkeje so preučevane podporne ES (26; 11,6 %).

Najpogosteje obravnavana posamezna ES je kulturna ES, in sicer rekreacija in ekoturizem (18 raziskav), sledita ji uravnalna ES uravnavanje naravnih nesreč in oskrbovalna ES materiali, vsaka s 16 raziskavami. Med slednjo štejemo les kot material in kot kurivo ter druge materiale (na primer krma, šota, pridelava energetskih in industrijskih rastlin). Med uravnalnimi ES izstopajo še uravnavanje pod-

nebja (skladiščenje ogljika) (15 raziskav), čiščenje vode in zadrževanje onesnažil (14 raziskav) ter uravnavanje vode (14 raziskav). Pri oskrbovalnih ES izstopajo preučevanje hrane (14 raziskav), kmetijski pridelki (10 raziskav) in pitna voda (11 raziskav). Enkrat je obravnavana ES biokemikalije, naravna zdravila in učinkovine ter po dvakrat uravnavanje bolezni in škodljivcev, znanje, navdih, socialni odnosi, fotosinteza in vodni krog. Edina ES iz klasifikacije MEA, ki v izbranih raziskavah ni bila preučevana, je kulturna raznolikost.

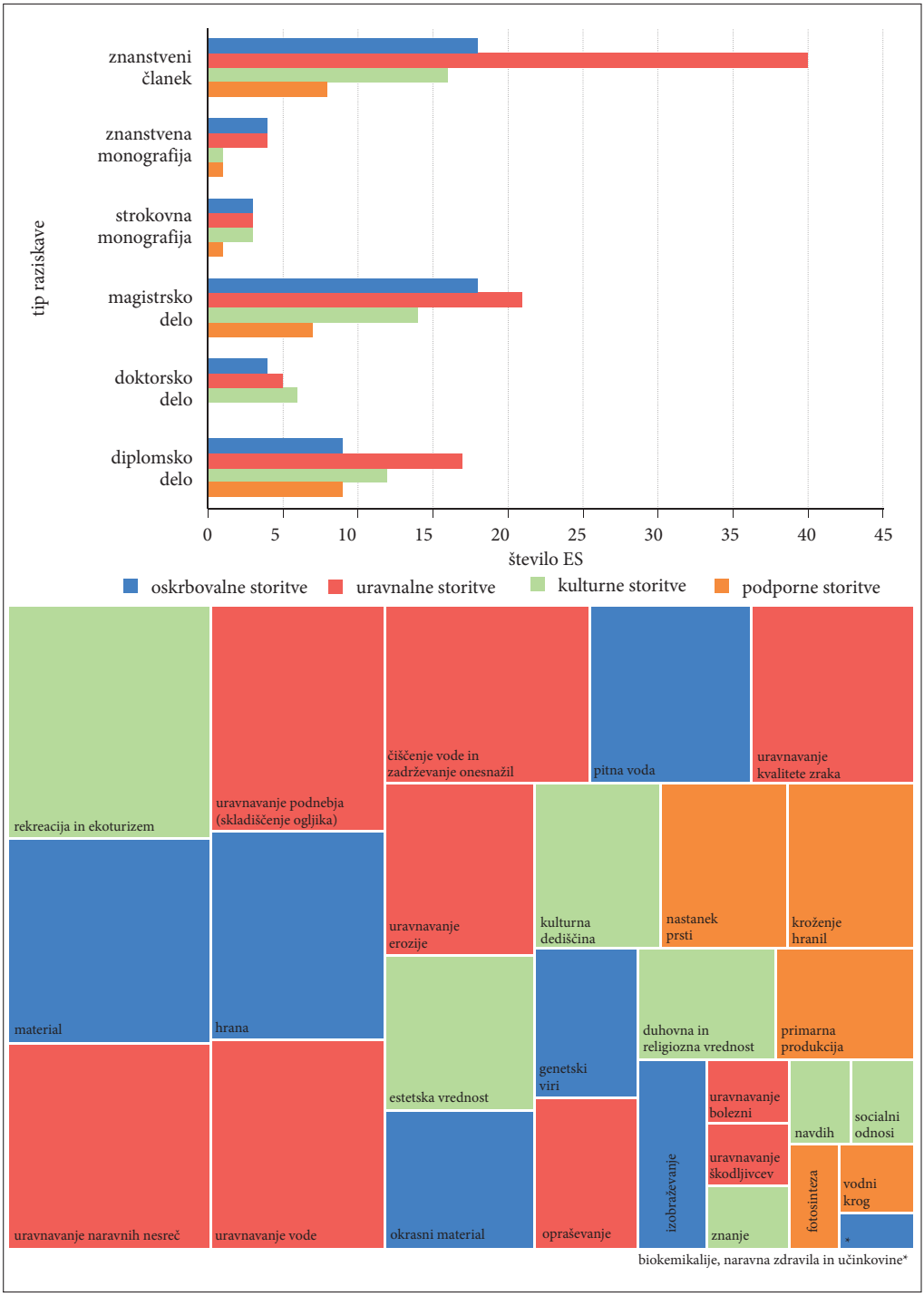
Pri podpornih ES izstopata nastanek prsti in kroženje hranil. Identificirali smo še nekatere druge ES, ki so bile predmet raziskav, a jih nismo mogli umestiti v klasifikacijo MEA (na primer dobro počutje, prostor za razmišljanje, abiotska heterogenost, biotski pretok vode, voda za energijo). Glavnina raziskav (21; 84,0 %) je med preučevanje ES vključila tudi biotsko raznovrstnost, habitat/življenjska okolja in naravno dediščino.

Skupina MAES je pri svoji študiji stanja ES na evropski ravni izhajala iz stanja ekosistemov in njihovih ES (MAES 2011), zato smo pri raziskavah s poglobljeno obravnavo podrobneje pogledali povezave



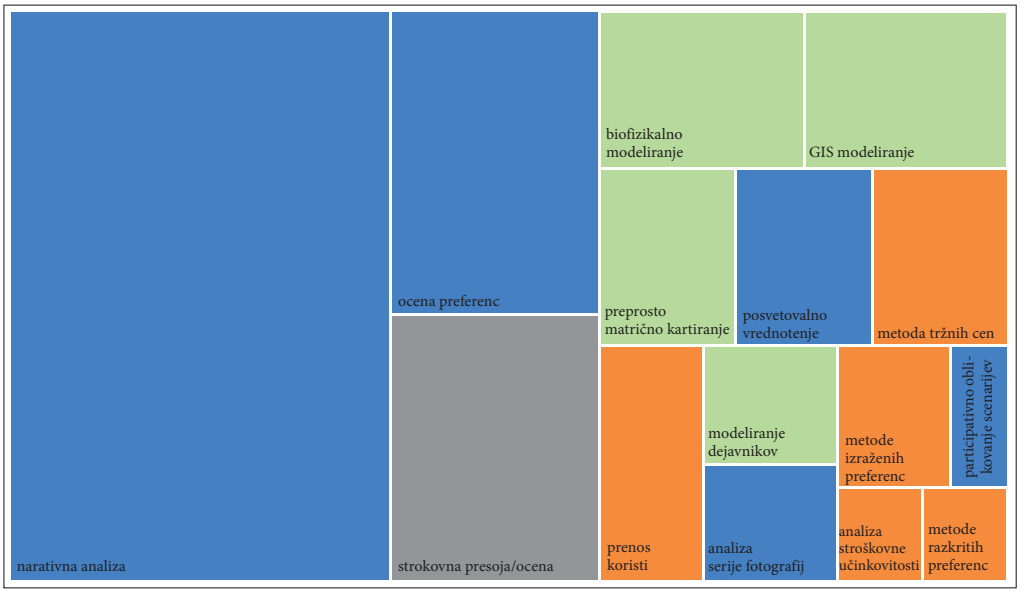
Slika 7: Raziskave po preučevanju ekosistemov po tipologiji MAES in po tipih raziskav.

Slika 8: Raziskave ES po klasifikaciji MEA in po tipih raziskav (zgoraj) ter grafični prikaz pogostosti obravnave posameznih ES po klasifikaciji MEA (spodaj) – površina štirikotnika je proporcionalna z deležem vseh preučevanih ES (n=224). ➤ *str. 50*


tip raziskave
znanstveni članek
znanstvena monografija
strokovna monografija
magistrsko delo
doktorsko delo
diplomsko delo
0
5
10
15
20
25
30
35
40
45
število ES
oskrbovalne storitve
uravnalne storitve
kulturne storitve
podporne storitve
rekreacija in ekoturizem
uravnavanje podnebja (skladiščenje ogljika)
čiščenje vode in zadrževanje onesnažil
pitna voda
uravnavanje kvalitete zraka
material
hrana
uravnavanje erozije
kulturna dediščina
nastanek prsti
kroženje hranil
genetski viri
duhovna in religiozna vrednost
primarna produkcija
estetska vrednost
uravnavanje bolezni
navdih
socialni odnosi
izobraževanje
uravnavanje škodljivcev
fotosinteza
vodni krog
znanje
*
uravnavanje naravnih nesreč
uravnavanje vode
okrasni material
opraševanje
biokemikalije, naravna zdravila in učinkovine*

med preučevanimi ekosistemi in ES. Kar 15 od 17 tovrstnih raziskav je preučevalo ES **gozdnega ekosistema,** kjer smo odkrili največ različnih ES. Najpogosteje so obravnavale materiale (les), rekreacijo in ekoturizem, uravnavanje podnebja (skladiščenje ogljika) in uravnavanje naravnih nesreč. Pet raziskav je preučevalo **travniški ekosistem**, po štiri **urbane** (in grajene) in **kmetijske ekosisteme**. Pri vseh omenjenih ekosistemih izstopa raziskovanje oskrbovalnih ES, predvsem hrane in materialov (les). V sklopu uravnalnih ES so se raziskave osredotočale na uravnavanje podnebja (skladiščenje ogljika), pri kulturnih pa na rekreacijo in ekoturizem, kulturno dediščino in estetsko vrednost. Podporne ES so preučevali le pri gozdnem – največkrat nastanek prsti (5 raziskav) – in urbanem ekosistemu ter pri tleh. Pri vseh zgoraj omenjenih ekosistemih so kot ES preučevali tudi biotsko raznovrstnost.

Med možnimi metodološkimi pristopi obravnave ES – klasifikacijo 26 metod v 4 skupine (biofizikalne, socio-kulturne, monetarne in integrativne metode) smo povzeli po Harrison s sodelavci (2018) –, je bila najpogosteje (27; 69,2 %) uporabljena narativna analiza (slika 9). Ta metoda obravnava ES predvsem s kvalitativnim opisom stanja ES (Zupanc, Pintar in Podgornik 2018), relevantne zakonodaje (Muršič 2019; Vuletič s sodelavci 2020) ali odnosov med deležniki (Nichiforel s sodelavci 2018). Sem spadajo tudi pregledi literature oziroma preteklih raziskav, običajno s postavljanjem konteksta raziskave ali celo z analizo rezultatov drugih raziskav zaradi validacije raziskovalnih izsledkov. Manj pogosto – v približno petini raziskav – sta bili uporabljeni ocena preferenc (8; 20,5 %) (Torkar, Verlič in Vilhar 2014; Ranacher s sodelavci 2017) in strokovna presoja (7; 17,9 %) (Peters s sodelavci 2015; Ribeiro in Šmid Hribar 2019). Ocena preferenc vključuje različne načine zbiranja podatkov o posameznikovih željah, potrebah, zadržkih itd., vse tja do različnih vidikov obravnave ES. Nikjer niso uporabljene kakršnekoli oblike ekonomskih vrednosti, temveč so preference izražene z rangiranjem, ocenjevanjem, razporejanjem ali parnimi primerjavami. To najpogosteje poteka s pomočjo vprašalnikov, fokusnih delavnic in intervjujev. Strokovno presojo smo uvrstili v posebno skupino metodoloških pristopov, v kateri se o analiziranih vidikih ES odloča nekdo s strokovnim znanjem, kar zadošča za konsistentno oceno. Kljub temu da je



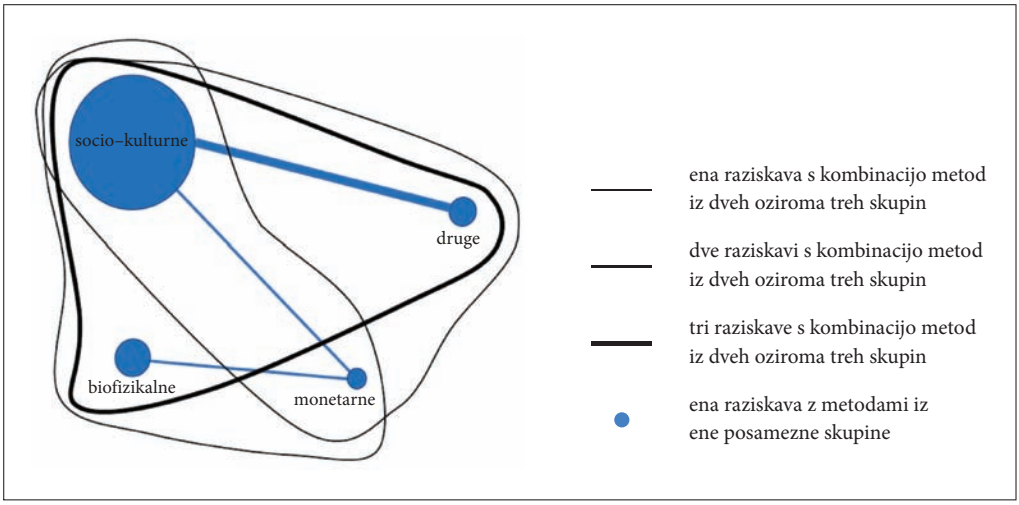
Slika 9: Grafično prikazana pogostost uporabe različnih metod obravnave ES – površina štirikotnika je proporcionalna z deležem raziskav (n=39), v katerih je bila uporabljena posamezna metoda. Temno modra barva predstavlja socio-kulturne metode, zelena biofizikalne metode, rumena metode monetarnega vrednotenja ter siva pristop strokovne presoje/ocene.

lahko pristop zelo pristranski in hkrati nepreverljiv, se precej pogosto uporablja. V desetini raziskav (4; 10,3 %) je bilo uporabljeno biofizikalno modeliranje (Rudolf 2008; Železnikar 2015; Costantini s sodelavci 2018), enako velja za pristop z GIS modeliranjem (Grilli s sodelavci 2017; Ribeiro in Šmid Hribar 2019; Vilhar in Kozamernik 2020). V prvem primeru gre za kvantitativno analizo biofizikalnih dejavnikov, ki lahko vplivajo na stanje ES, praktično pa se tovrstna analiza izvaja s pomočjo različnih ekoloških in hidroloških modelov ter modelov erozije prsti in podobno. GIS modeliranje običajno vključuje uporabo prostorskih podatkov, in to z njihovim združevanjem ter ustvarjanjem sinteznih kazalnikov, s katerimi je mogoče oceniti stanje ali pa napovedovati prihodnji razvoj ES. Drugi metodološki pristopi so bili uporabljeni v manj kot 10 % raziskav.

Metodološki pristopi se lahko v istih raziskavah tudi združujejo oziroma povezujejo. V 5 raziskavah (12,8 %) sta bili uporabljeni metodi iz dveh različnih metodoloških skupin, v dodatnih 5 raziskavah pa metode iz kar treh različnih skupin. Na sliki 10 je prikazano, kako pogosto so bili v istih raziskavah uporabljeni metodološki pristopi znotraj štirih agregiranih skupin metodoloških pristopov. V treh primerih (Peters s sodelavci 2015; Costantini s sodelavci 2018; Vrščaj 2018) so bile uporabljene metode iz skupine socio-kulturnih in drugih metodoloških pristopov, v enem primeru metode iz skupin socio-kulturnih in monetarnih metod (Japelj 2016) in v enem iz skupin biofizikalnih in monetarnih metod (Areh 2016).

V treh primerih so bile uporabljene metode iz treh skupin hkrati, in sicer iz skupine socio-kulturnih, biofizikalnih in drugih metod (Šmid Hribar 2014; Železnikar 2015; Ribeiro in Šmid Hribar 2019). V eni raziskavi (Grilli s sodelavci 2017) so bile uporabljene metode socio-kulturnih, monetarnih in biofizikalnih metodoloških skupin ter v eni raziskavi (Vurunić 2015) metode socio-kulturnih, monetarnih in drugih skupin metod. Skupno tem raziskavam je, da so z izjemo Grilli s sodelavci (2017), ki se osredotoča na gozd, obravnavale več različnih ekosistemov hkrati. Pestrost obravnavanih ekosistemov običajno prinaša tudi raznolikost ES, to pa hkrati pomeni uporabo različnih metodoloških pristopov.

Ne velja le, da hkratna obravnava več ekosistemov prinaša tudi več metodoloških pristopov, temveč da nekateri posamezni ekosistemi zagotavljajo več ES hkrati, kar pomeni tudi več metodološke

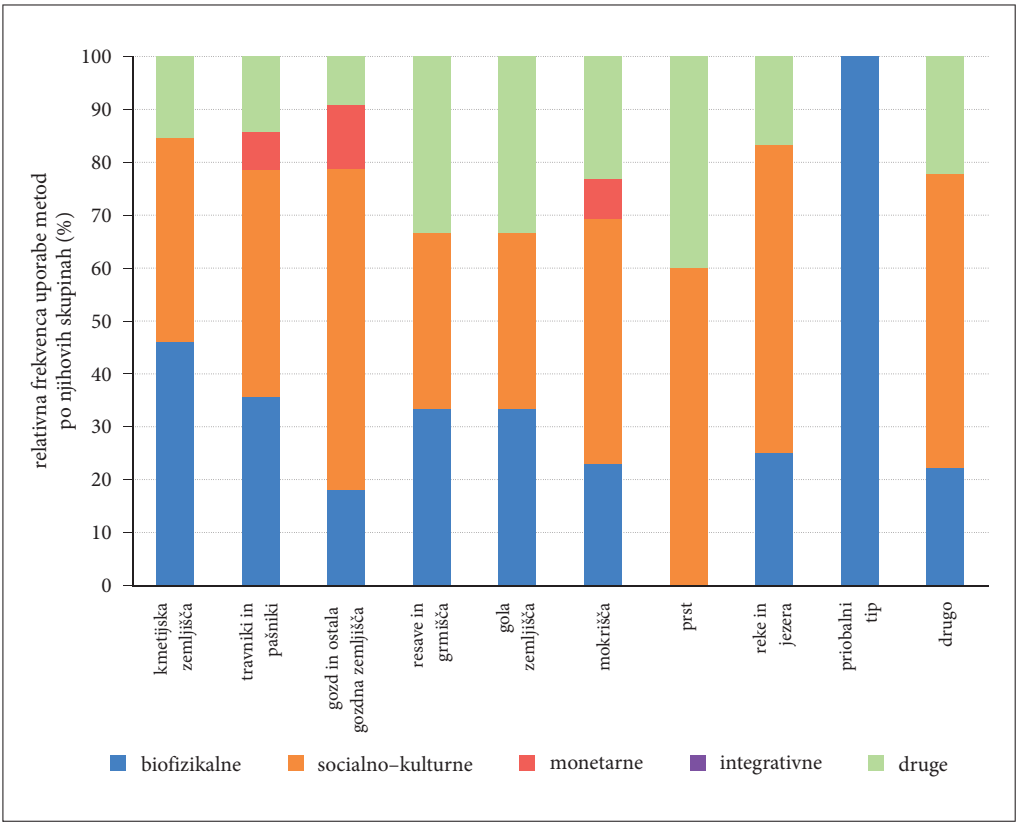


Slika 10: Kako pogosta je uporaba metod obravnave ES po štirih skupinah (socio-kulturne, biofizikalne, monetarne, druge). Velikost kroga predstavlja število raziskav, v katerih so bile uporabljene metode iz posamezne skupine, debelina črte med njimi število raziskav z uporabljenimi metodami iz dveh različnih skupin in debelina meje poligona število raziskav z uporabljenimi metodami iz treh skupin hkrati.

raznolikosti. Na sliki 11 je prikazana relativna pogostost uporabe različnih metod v povezavi z ekosistemi, ki so bili obravnavani v raziskavah. Kot je že predhodno izpostavljeno, prevladujejo v skoraj vseh primerih socio-kulturne metode, hkrati pa je očitno, da je raznolikost metodološkega pristopa največja pri obravnavi travnikov in pašnikov, gozdov in mokrišč. Manjša pestrost metodoloških pristopov je opazna pri raziskavah ES prsti in ES priobalnih tipov ekosistemov.

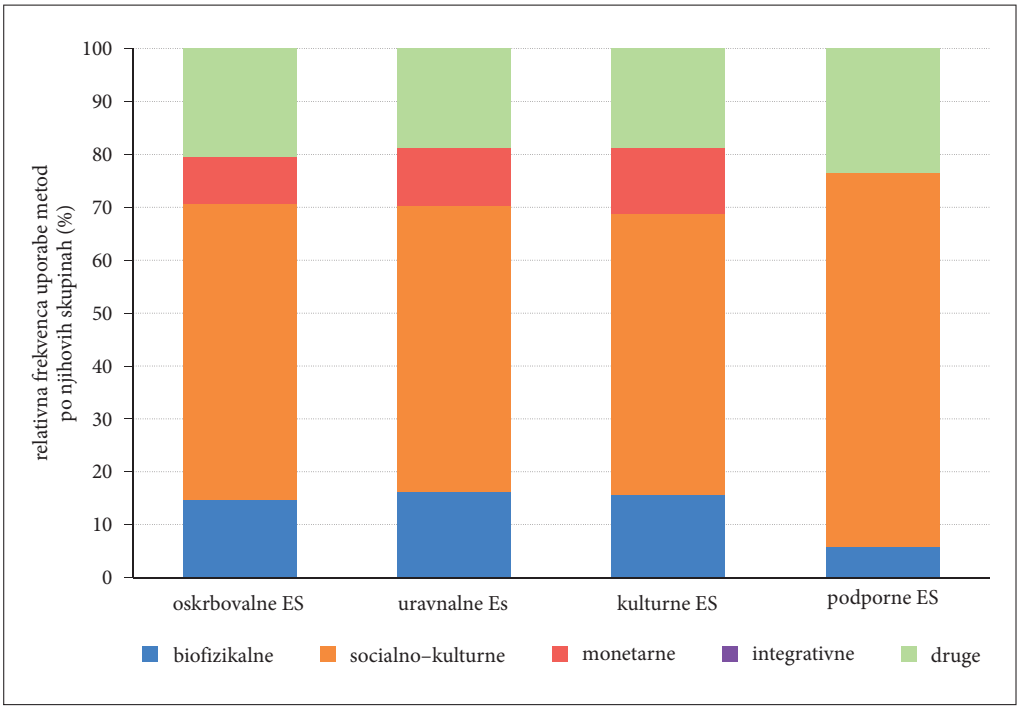
Obravnava povezanosti med obravnavanimi ES in metodološkimi pristopi pokaže (slika 12), da je ta povezava precej enovita oziroma da pri obravnavi ES iz skupin oskrbovalnih, uravnalnih in kulturnih ES prevladuje raba socio-kulturnih metod, v približno enakih deležih sledijo biofizikalne in druge oblike metod, najmanj pogosto pa so bile uporabljene monetarne metode. Slednje niso bile nikoli uporabljene za obravnavo katerekoli od podpornih ES.

Največ raziskav je ES obravnavalo na lokalni (11; 28,2 %), regionalni (9; 23,1 %) in državni (11; 28,2 %) prostorski ravni. Na mednarodni ravni smo zabeležili le 4 raziskave, preostale 4 niso imele opredeljene prostorske ravni (na primer Žujo in Danev 2010, ki ES obravnavata z metodološkega vidika). Pregled ekosistemov po prostorskih ravneh pokaže, da se je gozd največkrat pojavljal na državni ravni, kmetijska zemljišča, mokrišča, urbani (in grajeni) ekosistemi, travniki in pašniki, reke in jezera pa na lokalni ravni. Po skupinah si metode sledijo takole: biofizikalne metode so uporabljene le na lokalni in regionalni ravni, monetarne na lokalni, regionalni in državni, socialno-kulturne metode, kjer izstopata narativna analiza in analiza preferenc, pa na vseh prostorskih ravneh.



Slika 11: Relativna pogostost uporabe različnih metod v raziskavah ES glede na obravnavane tipe ekosistemov.

Avtorji so ES v Sloveniji najpogosteje preučevali na zavarovanih območjih, vodnih površinah (porečja, ribniki, jezero) ali znotraj administrativnih enot (občine, statistična regija, območna enota Zavoda za gozdove Slovenije), ki pa se po velikosti precej razlikujejo (slika 13).

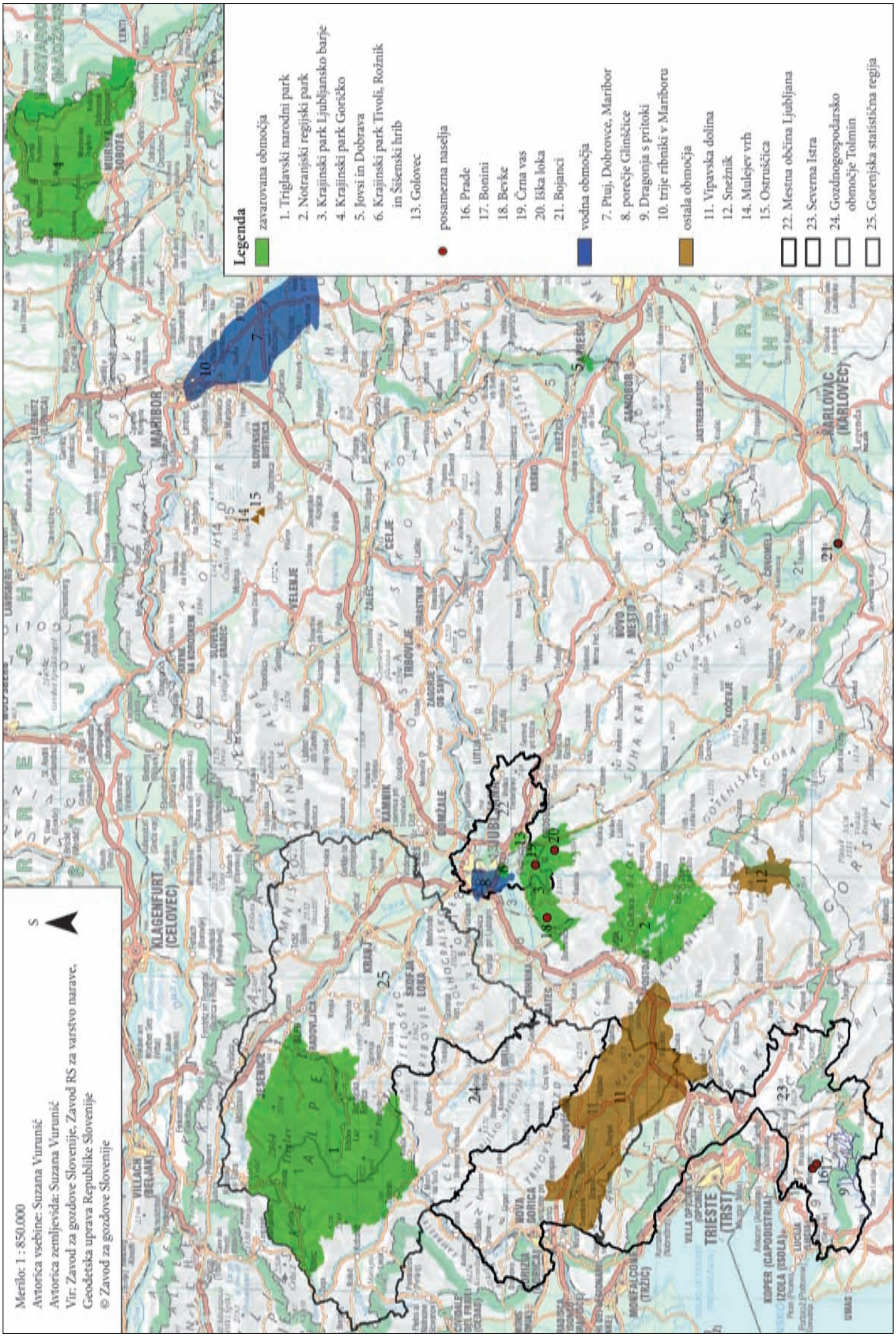


Slika 12: Relativna pogostost uporabe različnih metod v raziskavah ES glede na skupine obravnavanih ES.

5 Razprava

Časovna dinamika raziskav ES v Sloveniji kaže kljub majhnemu vzorcu, ki omejuje zanesljivost sklepanja, na trend naraščanja raziskav in s tem na krepitev tega raziskovalnega področja. To velja predvsem za znanstvene članke, manj pa za diplomska, magistrska in doktorska dela, saj po letu 2018 teh tipov raziskav nismo več zaznali. Podobne trende ugotavljajo tudi nekatere druge raziskave (Kull s sodelavci 2015; McDonough s sodelavci 2017; Xie s sodelavci 2020). V svetovnem merilu število raziskav še posebno narašča od 2014. K naraščanju objavljenih raziskav s področja ES so brez dvoma pripomogle nove mednarodne revije, kot na primer *Ecosystem Services*, ki izhaja od 2012 naprej in v kateri je več kot 1000 znanstvenih člankov, a nobenega iz našega nabora. Dejstvo, da smo v Sloveniji dobili prvo poglobljeno raziskavo šele leta 2013, kaže na to, da koncept ES pri nas sprva ni bil posebej uveljavljen. Po drugi strani pa ni nujno, da so novejše raziskave tudi bolj poglobljene, ravno nasprotno. Presenetila nas je ponovna rast števila raziskav, predvsem znanstvenih člankov, ki ES obravnavajo šibko. To pomeni, da se zmanjšuje delež raziskav, v katerih so ES osrednja tema preučevanja, in povečuje delež takšnih, ki obravnavajo ES kot dopolnilo za povečanje privlačnosti. Slovenija si je v Resoluciji o nacionalnem programu varstva okolja za obdobje 2020–2030 (2020) med cilji na področju ohranjanja biotske

Slika 13: Karta pilotnih območij raziskav ES v Sloveniji. ►


Legenda
zavarovana območja
1. Triglavski narodni park
2. Notranjski regijski park
3. Krajinski park Ljubljansko barje
4. Krajinski park Goričko
5. Jovsi in Dobrava
6. Krajinski park Tivoli, Rožnik in Šišenski hrib
13. Golovec
posamezna naselja
16. Prade
17. Bonini
18. Bevke
19. Črna vas
20. Iška loka
21. Bojanci
vodna območja
7. Ptuj, Dobrovce, Maribor
8. porečje Glinščice
9. Dragonja s pritoki
10. trije ribniki v Mariboru
ostala območja
11. Vipavska dolina
12. Snežnik
14. Mulejev vrh
15. Ostruščica
22. Mestna občina Ljubljana
23. Severna Istra
24. Gozdnogospodarsko območje Tolmin
25. Gorenjska statistična regija
Merilo: 1 : 850.000
Avtorica vsebine: Suzana Vurunić
Avtorica zemljevida: Suzana Vurunić
Vir: Zavod za gozdove Slovenije, Zavod RS za varstvo narave, Geodetska uprava Republike Slovenije
© Zavod za gozdove Slovenije

raznovrstnosti in varstva naravnih vrednot od leta 2022 naprej zadala tudi kartiranje in ovrednotenje ekosistemskih storitev ter vključevanje njihove vrednosti v pripravo in sprejem razvojnih, prostorskih in drugih strateških ali operativnih dokumentov (cilj 1/8, št. ukrepa 44), zato bomo za uresničitev tega cilja v prihodnje potrebovali več bolj poglobljenih in celovitih raziskav ES.

Če sta bila sprva glavna motiva ozaveščanje o pomenu ES in ocena razpoložljivosti, se v zadnjih letih raziskave vse pogosteje izvajajo tudi za zagotovitev podatkov pri podpori odločanju o oblikovanju strategij in politik ter za oceno vpliva posamezne prakse na ES in preveritev odnosa javnosti do posameznih ES. Prav ti motivi so bili največkrat gonilna sila poglobljenih raziskav ES. Pregled raziskav je še potrdil, da je koncept ES kompleksen in da pogosto zahteva raziskovalce z različnih znanstvenih področij. Nekateri članki v naši raziskavi vključujejo celo po pet različnih področij (na primer Keesstra s sodelavci 2018; Báliková s sodelavci 2019), med katerimi je imelo primat gozdarstvo; lahko so plod projektov EU, na primer Akcij COST.

Raziskave na lokalni, regionalni in državni prostorski ravni so številčno sorazmerno enakomerno razporejene. Ni presenečenje, da raznolikost metod s prehajanjem na višje prostorske ravni upada, saj so za preučevanje ES potrebni kakovostni in zanesljivi podatki, dobro znanje in dovolj časa. Po drugi strani pa so najbolj raznoliki motivi za izvedbo raziskav na državni ravni, kjer se poleg bolj splošnih motivov, kot sta na primer ocenjevanje razpoložljivosti ES in ozaveščanje javnosti, iščejo načini, kako koncept ES integrirati z drugimi koncepti (na primer za gozdne ES in funkcije gozdov glej Bončina, Simončič in Rosset 2019) in kako vpeljati plačila za ES predvsem v gozdnem ekosistemu, ki nudi najbolj raznolike ES različnim deležnikom (tako lastnikom kot tudi splošni javnosti).

5.1 Ekosistemi, ekosistemske storitve in metode v preučevanih raziskavah

Ugotavljamo, da avtorji z različnih znanstvenih področij pri preučevanju ES večinoma obravnavajo po en ekosistem. Najpogosteje obravnavan ekosistem je gozd, kar ni presenetljivo, saj večina raziskav izhaja iz gozdarstva. Velik delež raziskav s področja gozdarstva je najverjetneje posledica dejstva, da slovensko gozdarstvo že vsaj nekaj desetletij uresničuje konceptualno podoben sistem funkcij gozdov, zato ideja ES ne prinaša prelomnice v ideji večnamenskega in trajnostnega gospodarjenja z gozdom. Po drugi strani geografi praviloma preučujejo kulturno pokrajino, ki je zaradi prepleta različnih ekosistemov (največkrat njiv, travnikov, sadovnjakov, mejic in gozda) večnamenska in zagotavlja vse glavne skupine ES (oskrbovalne, uravnalne, kulturne in podporne). V tovrstnih primerih gre običajno za ocene razpoložljivosti ES iz obstoječih matrik, ki so bolj ali manj prilagojene konkretnemu območju. Prednost takšnega pristopa je v celovitem in hkratnem obravnavanju različnih (multiple) ES, ki so na izbranem območju lahko v konfliktu, zato se je treba odločati, kateremu ekosistemu dati prednost (*trade-offs;* ali na primer varovati mokrotni travnik ali tam obdelovati njivo). Tak pristop omogoča dialog med različnimi deležniki ter iskanje sinergij o prihodnjem razvoju in upravljanju območja.

Pomanjkanje raziskav ES je opazno pri vodnih ekosistemih, to še posebej velja za morske ekosisteme. Tudi pri prsteh kot izjemno pomembnem viru za človekovo preživetje zeva vrzel v njihovi vlogi pri zagotavljanju ES. Voda in prst se čedalje pogosteje ter močneje izpostavljata kot strateški dobrini 21. stoletja, prva v luči privatizacije vodnih zemljišč in neprimernih posegov v obvodna območja, druga pa z izpostavljanjem degradacije zemljišč, s pozidavo rodovitnih tal in onesnaževanjem, zato bodo nujne raziskave ES, ki jih prispevata ti dve dobrini.

Med posameznimi ES so v naši analizi izstopale ES rekreacija in ekoturizem, uravnavanje naravnih nesreč in oskrba z materiali, za katere je na voljo dosti podatkov in metod, s katerimi jih lahko ocenjujemo. Po drugi strani med preučevanimi skupinami ES izstopa preučevanje uravnalnih ES, ne pa oskrbovalnih ali kulturnih, čeprav uravnalne običajno zahtevajo bolj napredne in kompleksnejše metodološke pristope. Zdi se, da z raziskavami v Sloveniji podpiramo osnovni namen koncepta ES, to je podpora trajnostne rabe naravnih virov. Poleg tega večina analiziranih raziskav kot eno izmed ES izpostavlja tudi biotsko raznovrstnost ali obravnava varovana območja narave. A hkrati ugotavljamo,

da ni nobena raziskava za razdelitev in osnovanje kazalnikov preučevanja ES uporabila klasifikacije CICES (Common … 2018), ki je bila razvita ravno z namenom, da se ES podrobneje in celoviteje obravnavajo. Poleg tega je očitno, da pri nas še vedno ni jasno, kam se umešča biotska raznovrstnost – ali je to samostojna ES ali pa podlaga za delovanje ekosistemov – in da je ne smemo obravnavati ločeno, kot je to razumljeno v novejši CICES (Common … 2018) klasifikaciji.

Z vidika uporabe različnih metod za obravnavo ES je presenetljiva precejšnja uporaba ekspertne ocene pri raziskavah, objavljenih v člankih (7; 17,9 %). S tem pristopom skupina avtorjev na podlagi lastne presoje in predhodnega poznavanja problematike sama oceni ES, zato je deloma tvegan, saj ne moremo presoditi njegove zanesljivosti. Na to opozarja tudi Seppelt s sodelavci (2011), ki trdi, da različnim metodološkim pristopom ne gre pripisati enake teže, temveč je treba zanesljivost rezultatov kritično presojati. V vseh obravnavanih raziskavah je sicer ta pristop uporabljen v kombinaciji z drugimi metodami. Ravno z analizo raziskav, v katerih je bilo uporabljenih več metod hkrati, smo ugotovili, da je to običajno v primerih, ko je obravnavanih več ekosistemov oziroma ES hkrati. Naša analiza je povezavo med pestrostjo obravnavanih ekosistemov in metodoloških pristopov sicer zasledila, vendar je to zakonitost treba interpretirati z zadržkom, saj Kopperoinen, Varumo in Maes (2018) opozarjajo, da je mogoče iste metode uporabiti v različnih analitičnih kontekstih.

6 Sklep

Leta 2005 so Združeni narodi objavili poročilo MEA, da bi ozavestili raziskovalno in širšo javnost o siromašenju ter uničenju ekosistemov na globalni ravni in posledicah tega za življenja ljudi. S poročilom so izpostavili, da je treba sprejeti ustrezne ukrepe za izboljšano upravljanje ekosistemov. Od takrat pa do danes se je obravnava ES razvijala tudi v Sloveniji, vendar ostaja do celovite rabe koncepta kar nekaj izzivov. Presenetilo nas je, da gonilna sila raziskav ni bilo varstvo narave in da koncepta niso vzeli za svojega naravovarstveniki. Pričujoči pregled je pokazal, da so se raziskave izvajale predvsem za ocenjevanje razpoložljivosti ES in ozaveščanje o pomenu ES, kar naj bi pomagalo pri odločanju in oblikovanju ustreznih strategij in politik. Po sistematičnem kartiranju literature v bazah Scopus, Wos in Cobiss je bilo v Sloveniji v obdobju od januarja 2005 do 21. avgusta 2020 objavljenih 39 raziskav (25 znanstvenih in strokovnih člankov in monografij ter 14 diplomskih, magistrskih in doktorskih del), v katerih so avtorji preučevali ES. V nadaljevanju izpostavljamo ključne ugotovitve.

Prvič, število raziskav narašča, kar kaže na povečano zanimanje za ES. Zelo verjetno bi pregled dodatnih virov, ki niso v bibliografskih bazah, pokazal, da je teh raziskav še več. Vendar se jih med izbranimi raziskavami le manjši delež ukvarja z ekonomskim vrednotenjem, kartiranjem in ocenjevanjem ES, medtem ko scenarijev razvoja, sprejemanja ukrepov na podlagi analize ES, vključevanja v plačila za ES (*payments for ES – PES*) in podobno sploh nismo zaznali. Še več, analiza kaže, da se delež raziskav, ki poglobljeno obravnavajo ES, v zadnjih letih zmanjšuje.

Drugič, pri dobrih dveh tretjinah raziskav prihaja prvi avtor z naravoslovnega področja, pri čemer prevladuje gozdarstvo; posledično je gozd največkrat preučevan ekosistem. Na družboslovnem področju izstopata geografija in preučevanje več ekosistemov, včasih tudi celotne rabe tal znotraj kulturne pokrajine. To sta tudi dva glavna pristopa pri preučevanju ES – bodisi razpoložljivost posameznih ES znotraj enega ekosistema na različnih prostorskih ravneh bodisi razpoložljivost širokega izbora vseh skupin ES v kulturni pokrajini na lokalni ravni.

Tretjič, analiza izbranih 25 raziskav je pokazala, da izrazito prednjači raziskovanje uravnalnih ES, najredkeje pa so preučevane podporne ES. Najpogosteje obravnavana posamezna ES je kulturna ES, in sicer rekreacija in ekoturizem. Sledita ji uravnalna ES uravnavanje naravnih nesreč in oskrbovalna ES materiali (predvsem les).

In **četrtič**, po pogostosti uporabe različnih metodoloških pristopov močno prevladuje – v dveh tretjinah raziskav – narativna analiza, ki omogoča tako kvalitativno kot kvantitativno obravnavo ES. Vzrok

je verjetno v tem, da lahko metodo uporabimo za zelo različne formate podatkov z raznoliko stopnjo zanesljivosti, kar je značilno za področja v začetnih razvojnih fazah raziskovanja, ko sistematično zbrane podatkovne zbirke še niso na voljo. Sledijo metode (neekonomskega) ocenjevanja preferenc s pomočjo rangiranja, ocenjevanja, razporejanja, strokovne presoje ter biofizikalno in GIS modeliranje.

Predvsem pogrešamo bolj celostno in poglobljeno obravnavo ES, ter spodbujamo pripravo kratke, a jasne strategije o tem, kako bi nam v Sloveniji koristilo vključevanje koncepta ES, katerim deležnikom, s kakšnim namenom in na katerih prostorskih ravneh. Pričakovati je, da se bodo konflikti, povezani z rabo naravnih virov, vsaj na bolj poseljenih območjih v prihodnje povečevali in bomo rabili podatke ter orodja za presojanje koristi in prioritet. Raziskave o ES (ocena njihove razpoložljivosti in koristi) na različnih prostorskih ravneh bodo za tovrstne presoje nujne in bodo pomagale odločevalcem pri oblikovanju konkretnih ukrepov za izboljšanje upravljanja z naravnimi viri. V prihodnjih slovenskih raziskavah o ES velja razmisliti, katera znanstvena področja se dobro dopolnjujejo in v katerih segmentih, saj iskanje sinergij in povezovanje v znanosti običajno prispeva 1) k bolj kompleksnim raziskavam, ki zmorejo osvetljevati več vidikov, včasih tudi nasprotujočih si; 2) k spoznavanju novih metod in pristopov, ki jih prispevajo različna znanstvena področja, kar lahko vodi do bolj celostnih in inovativnih rešitev in novih skupnih projektov.

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7 Viri in literatura

Glej angleški del prispevka.

Priloga 1: KODIRNA KNJIGA za pregledni članek Pregled raziskav s področja ekosistemskih storitev v Sloveniji.

1	KAZALNIKI ZA IDENTIFIKACIJO		Kategorije/opis
1.1	Leto objave		*Navedemo leto objave raziskave.*
1.2	Naslov članka		*Navedemo naslov članka.*
1.3	Avtorstvo in znanstveno področje	Avtor/ji (priimek, ime)	*Navedemo avtorje.*
		1.3a Sestava avtorstva	*Izberemo ustrezno:* 1. slovenski 2. tuji 3. mešani
		1.3b Institucija prvega avtorja	*Navedemo institucijo prvega avtorja.*
		1.3c Država prvega avtorja	*Navedemo državo prvega avtorja.*
		1.3d Znanstveno področje prvega avtorja	1. naravoslovje 2. družboslovje 3. tehnika 4. interdisciplinarna organizacija 5. neakademska organizacija
		1.3e Znanstveno področje avtorjev – podrobneje	*Izberemo ustrezno:* 1. gozdarstvo 2. ekologija in biologija 3. geografija 4. ekonomija 5. energetika 6. kmetijstvo 7. vodarstvo 8. pedagogika 9. pedologija 10. geologija (podzemne vode) 11. mednarodni odnosi 12. prostorsko planiranje 99. V primeru, da je znanstvenih področij več, iz navedenega seznama navedemo vsa znanstvena področja.
1.4	Tip članka		*Izberemo ustrezno:* 1. znanstveni članek 2. strokovni članek 3. sestavek v znanstveni monografiji 4. sestavek v strokovni monografiji 5. znanstvena monografija 6. strokovna monografija 7. diplomsko delo 8. magistrsko delo 9. doktorska disertacija

1.5	Jezik		*Izberemo ustrezno:* 1. slovenski 2. angleški
1.6	Ime revije, v kateri je bil članek objavljen		*Navedemo ime revije, v kateri je bil članek objavljen.*
1.7	Motivi za obravnavo ES		*Izberemo ustrezno:* 1. podlaga za plačilo ES 2. integracija koncepta ES z drugim konceptom 3. ozaveščanje 4. ocena vpliva prakse na ES 5. ocena razpoložljivosti ES 6. podpora odločanju, pomoč pri upravljanju in oblikovanju trajnostnih strategij in politik 7. ocena odnosa javnosti do ES 8. razvoj nove metode, kazalnika za ocenjevanje razpoložljivosti ES 9. predstavitev obstoječih orodij, metod, konceptov
2	KAZALNIKI ZA EKOSISTEMSKE STORITVE		Kategorije/opis
2.1	Preučevani ekosistemi	2.2a Raznolikost obravnavanih ekosistemov	*Izberemo ustrezno:* 1. posamezen ekosistem 2. več ekosistemov 3. raba tal v celotni kulturni pokrajini 4. ni ekosistema 5. drugo
		2.2b Preučevani ekosistemi po MAES tipologiji	*Izberemo ustrezno:* 1 urbani ekosistem 2 kmetijska zemljišča 3 travniki in pašniki 4 gozd in ostala gozdna zemljišča 5 resave in grmišča 6 gole površine 7 mokrišča 8 reke in jezera 9 brakična območja 10 obalni tip 11 priobalni tip 12 odprto morje 13 tla 14 drugo
2.2	Obravnavane ES po MEA klasifikaciji		ES1 OSKRBOVALNE STORITVE Hrana ES1.1 – kmetijski pridelki ES1.2 – reja živali in njihovi produkti ES1.3 – ribištvo ES1.4 – akvakultura ES1.5 – samonikle rastline, prostoživeče živali in glive

	Materiali ES1.6 – les ES1.7 – drugo (npr. bombaž, konoplja, svila) ES1.8 – les kot kurivo ES1.9 – genetski viri ES1.10 – biokemikalije, naravna zdravila in učinkovine ES1.11 – okrasni material ES1.12 – pitna voda ES2 URAVNALNE STORITVE ES2.1 – uravnavanje kvalitete zraka Uravnavanje podnebja (skladiščenje ogljika) ES2.2 – globalno ES2.3 – regionalno/lokalno ES2.4 – uravnavanje vode ES2.5 – uravnavanje erozije ES2.6 – čiščenje vode in zadrževanje onesnažil ES2.7 – uravnavanje bolezni ES2.8 – uravnavanje škodljivcev ES2.9 – opraševanje ES2.10 – uravnavanje naravnih nesreč ES3 KULTURNE STORITVE ES3.1 – kulturna raznolikost ES3.2 – duhovna in religiozna vrednost ES3.3 – znanje ES3.4 – izobraževanje ES3.5 – navdih ES3.6 – estetska vrednost ES3.7 – socialni odnosi ES3.8 – pomen prostora ES3.9 – kulturna dediščina ES3.10 – rekreacija in ekoturizem ES4 PODPORNE STORITVE ES4.1 – nastanek prsti ES4.2 – fotosinteza ES4.3 – primarna produkcija ES4.4 – kroženje hranil ES4.5 – vodni krog ES5 DRUGO ES5.1 – več ES ES5.2 – ES na splošno ES5.3 – druge ES (naštejemo)
2.3 Uporaba klasifikacije ES	*Izberemo ustrezno:* Da – navedemo katero klasifikacijo so uporabili (CICES, MEA, TEEB …) Ne

2.4	Stopnja obravnave ES v raziskavi	*Izberemo ustrezno:* 1. šibka obravnava (ES omenjene) 2. zmerna obravnava (ES del analize, a ne ocenjene) 3. poglobljena obravnava (kvalitativna in kvantitativna ocena ES)
2.6	Metode obravnave ES	*Izberemo ustrezno:* Biofizikalne metode 1. biofizikalno modeliranje 2. modeliranje ES 3. modeliranje dejavnikov 4. integrirani modeli ocene ES 5. GIS modeliranje 6. preprosto matrično kartiranje 7. napredno matrično kartiranje Socio-kulturne metode 8. posvetovalno kartiranje 9. participativno oblikovanje scenarijev 10. narativna analiza 11. posvetovalno vrednotenje 12. ocena preferenc 13. analiza serije fotografij 14. izvabljanje preferenc s fotografij 15. poraba časa Monetarne metode 16. analiza stroškovne učinkovitosti 17. analiza stroškov-koristi 18. metoda tržnih cen 19. metode razkritih preferenc 20. metode izraženih preferenc 21. renta naravnega kapitala 22. simulirana menjava 23. funkcija proizvodnje/stroškov 24. prenos koristi Integrativne metode 25. Bayesove mreže verjetja 26. več-kriterijsko odločanje Druge metode 27. strokovna presoja/ocena
2.7	Prostorska raven obravnave	*Izberemo ustrezno:* 1. lokalna 2. regionalna 3. državna 4. globalna
18	Konkretno območje obravnave	*Če je znano, zapišemo ime obravnavanega območja.*