Slovakia

State of the Art of ecosystem services assessment on a national level

In Slovakia, the concept of ecosystem services (ES) is relatively new and has not been sufficiently implemented. The basic framework is provided by Act No. 543/2002 Coll. on Nature And Landscape Protection in the current version, which was the first to define the ES at the national level and provided an initial legislative background. The ES concept is also incorporated in the Environmental Strategy of the Slovak Republic 2030. In its latest update, even the Fisheries Act introduced the ES concept related to fish protection. The ES concept is gradually being introduced in Slovakia, which is underpinned mainly by international commitments. It is necessary to continue to develop it in the Slovak Republic - not only within the framework of nature and landscape protection, but also in decision-making on landscape management, spatial and territorial planning, and environmental impact assessments, in local strategy papers, which are mandatory as part of applications for EU financial support.

An assessment of the **national landscape's potential for ES** provision (Fig. 1; based on evaluating the landscape units and selected properties and indicators at the ecosystem level). The highest capacity to provide ES in Slovakia comes from natural and semi-natural ecosystems, mainly deciduous, mixed and coniferous forests (Fig. 2) which cover over 38% of Slovak territory. The water ecosystems and wetlands are also significant, followed by grasslands and permanent crops. The research highlights the crucial importance of the mountainous and sub-mountainous areas in Slovakia. It confirms the **natural and semi-natural ecosystems' significant contribution to ensuring ES provision** (Mederly et al. 2020).

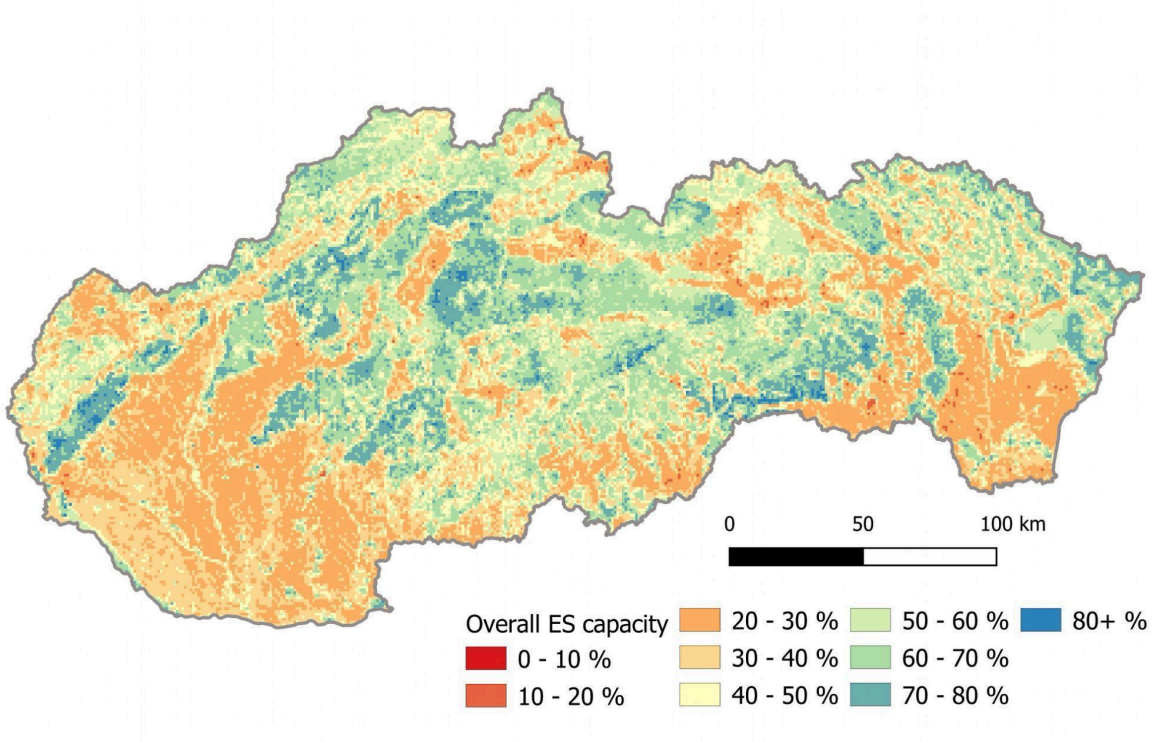

Fig. 1 The overall capacity of the landscape to provide ES (Mederly et al. 2020).

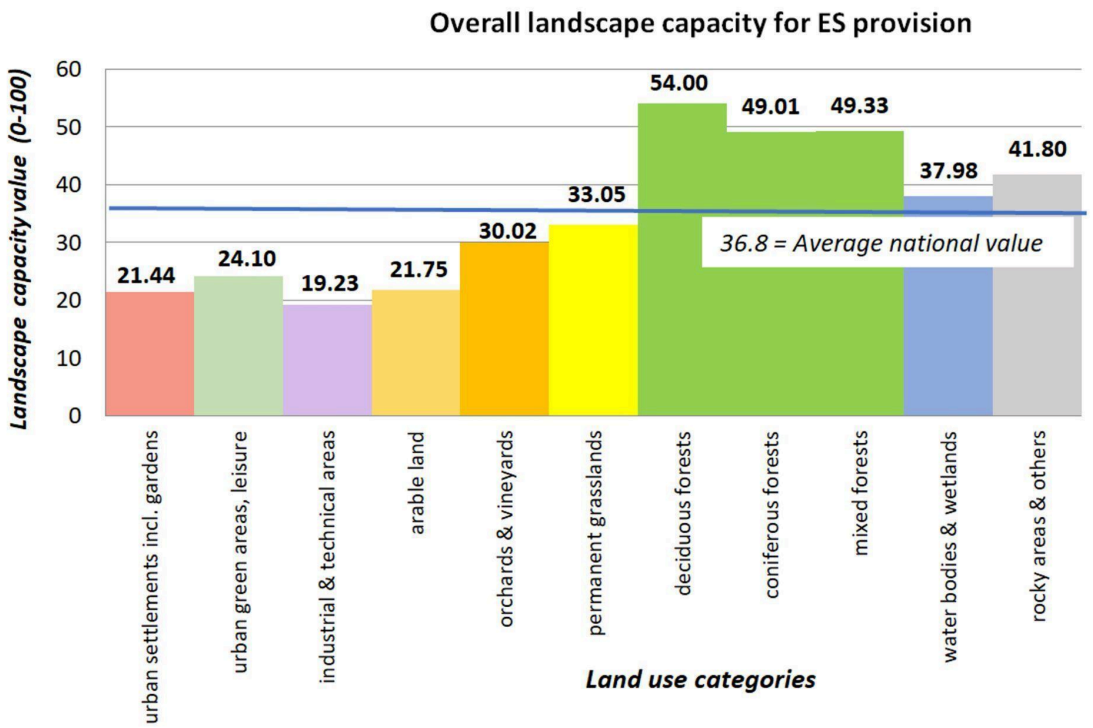

Fig. 2 The overall capacity of the landscape to provide ES for the main categories of land use (Mederly et al. 2020).

The landscape planning in Slovakia across national, regional, and local scales, focusing on the integration of ES concepts was examined by Bezák et al. (2017). The research reveals significant divergences and conflicts in environmental policy implementation at different spatial levels. The authors found that current spatial planning and assessment processes in Slovakia are often contradictory rather than integrated, with the ES concept notably absent from all planning tools. The paper proposes an ES-inspired integrated framework for landscape assessment and decision-making, which could enhance spatial planning processes in Slovakia. The authors argue that such improvements in planning and decision-making procedures could lead to real-world solutions that balance long-term human well-being with maintained ecosystem functions and processes.

A pilot assessment of agroecosystem services in Slovakia (addressing a key objective of the Slovak National Biodiversity Strategy for 2020) was conducted by Makovníková et al. (2020). The research was conducted at seven model sites representing different climatic areas and employed a transformed multi-criteria approach to estimate the agroecosystem services potential across the country. The findings suggest that the distribution of agroecosystem service values varies geographically, likely influenced by factors such as climate, slope, and soil texture. The authors argue that this assessment provides a foundation for further investigation of agroecosystem services and can contribute to optimizing sustainable land use management in Slovakia. This study represents an

important step in fulfilling national biodiversity objectives and offers insights into the spatial distribution of agroecosystem services in a rural, post-transformation country context.

State of the Art within/related to PAs

In terms of **nature and landscape conservation** in Slovakia, Mederly et al. (2020) assessed the **ES Supporting species and ecosystem diversity**. This ES most significantly supports nature and landscape conservation - this is evident in Fig. 3, which shows the relationship between the capacity of the landscape to provide this ES and the importance of the area in terms of nature and landscape conservation. In keeping with **Slovakia's natural and landscape conservation interests**, the primary *advantage of this ES is the enhancement of conditions for the preservation of the plant and animal gene pool, the development of appropriate habitats, and the provision of adequate food and sheltering opportunities for migrating species*. The existing network of PAs (national network of protected areas, areas belonging to the European network of protected areas NATURA 2000, internationally important areas identified according to various international conventions), as well as biocentres and biocorridors of territorial systems of ecological stability, are the most crucial tools from the perspective of protecting ecosystem and species diversity, ecological stability, and variability of Slovakia's entire landscape. A prerequisite for advancing ecosystem stability at the national level is the existing protected area system. However, the ongoing trend of biodiversity loss will not be stopped just because an area has been designated as protected. Therefore, management plans must be developed and authorized for each protected area, as well as that specific actions be taken to revitalize and preserve favorable conditions.

Mederly et al. (2020): "The capacity of current ecosystems to **support species and ecosystem diversity**, as well as the occurrence of genetically important species, can be expressed mainly in terms of indicators: the presence of important, rare and scarce species or habitats." The need for the conservation of species and ecosystem diversity is especially in the circle of experts, who, with a more thorough knowledge of rare and endangered species, as well as their specific conditions and threat factors, have a greater need for the conservation of biodiversity for future generations. Thus, the demand can be spatially differentiated, by the realistic provision of ES based on the condition of ecosystems, the quality of the environment, the representation of rare and close-to-nature habitats, etc.).

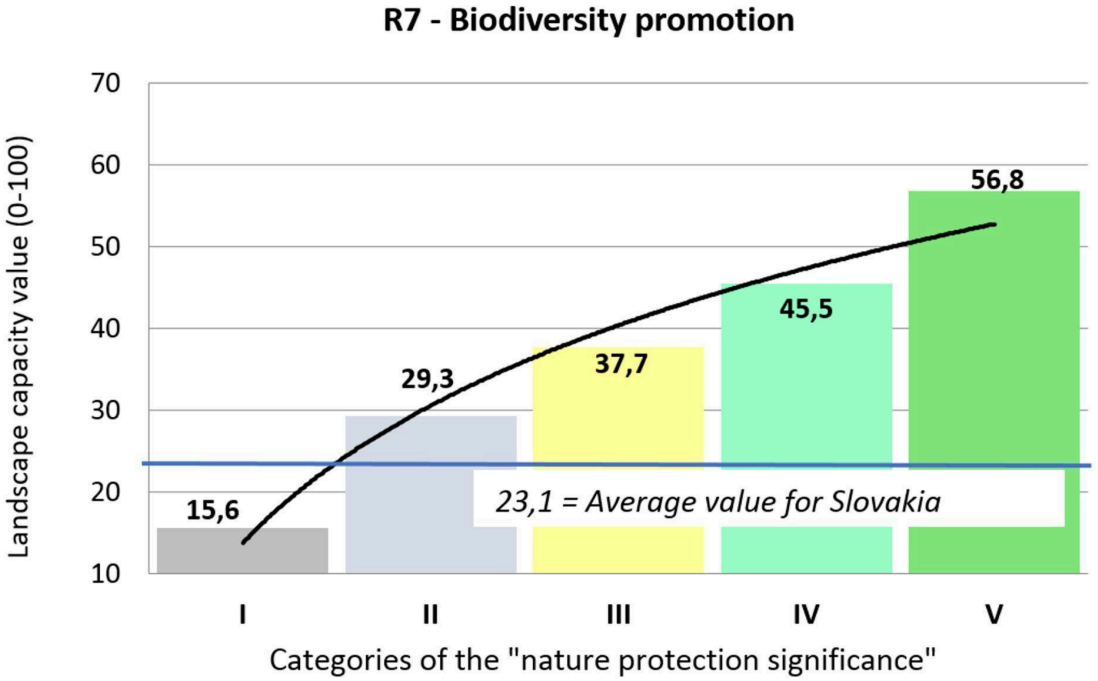

Fig. 3 Relationship of ***ES Supporting species and ecosystem diversity*** and the importance of the territory of Slovakia in terms of nature and landscape conservation (Mederly et al. 2020).

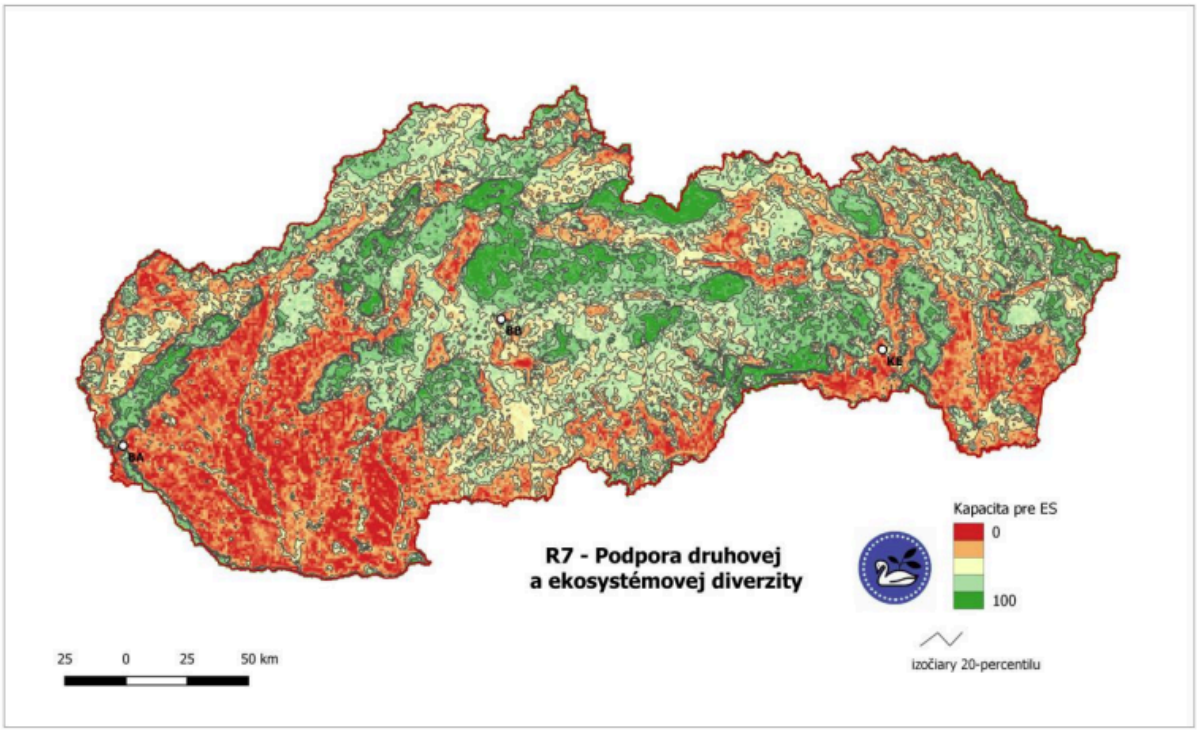

Fig. 4 ES Supporting species and ecosystem diversity (Mederly et al. 2020).

Černecký et al. (2020a) evaluated the potential and supply of the selected regulatory **ES Promoting biodiversity** (associated with the ES Regulating the spread of pests and

diseases). The assessment concluded that **natural and semi-natural habitats** are the most important for ES, thus again **highlighting the importance of the national network of PAs**, as these habitats are the subject of protection in PAs.

The ES concept in Slovakia is relatively **best developed for forestry and nature-protected areas**. The topic of forest ES and its assessment is mainly addressed by researchers at the National Forestry Centre and the Technical University of Zvolen. From the assessments of **ES of protected areas,** several studies were found:

State of the Art within/related to PAs

The case study results from PA Veľká Fatra (Považan et al., 2014a) show that this National Park provides important ESs for the local, regional, and national economies. In total, Veľká Fatra annually provides ESs worth EUR 179 million (about 4400 € per hectare). The national park secures manifold ESs such as recreational benefits (use values) for roughly 500000 visitors per year, and a range of non-use values (e.g., existence and bequest values) for the Slovakian population. In comparison, ecosystem services at Vel'ká Fatra are fewer than the benefits of the other national parks (i.e Tatra NP) due to the smaller recreational benefits. However, the results of the study ascertain that Veľká Fatra provides important ES for the Slovakian economy as a whole. With its services, the park generates value, which contributes significantly to people's well-being and the national economy.

Another research from Považan et al. (2014b) offers a straightforward methodology for quick evaluation and approximate valuation, as well as for elucidating certain fundamental ideas and methods in terms of a "value of ecosystem services expressed in money terms." PAs practitioners should use the findings of the preliminary valuation conducted by protected area managers using this methodology to persuade both themselves and others of the immense value of protected places, both their us and non use values. It should also be useful when arguing with decision-makers for policies that support the sustainable use of these resources or against initiatives that would undermine the national park's environment. Convincing people that protected areas offer more than just a place for scholars or nature lovers could be made easier with the help of this exercise.

The study from Muránska Planina National Park (Považan et al., 2015) offers more proof of the importance of (use and non-use values) ES in Slovakia´s PAs, which are estimated to be worth roughly EUR 10 million annually. Compared to some other Slovak NPs (i.e. Tatra NP), the park offers fewer ES in terms of forestry, agriculture, and tourism. Specifically, the benefits of recreation are diminished due to fewer visitors (30,000/year) and shorter average visiting time (2,29 days). Nevertheless, the study emphasizes how NP Muránska Planina greatly enhances human well-being and offers crucial ecosystem services to the national and regional economies.

A recent study (Kubak et al., 2020) related to Tatra NP aims to determine the economic value of this PA using the willingness-to-pay method. A questionnaire survey was applied to collect data (a hypothetical event - an annual entry fee to the Tatra NP). The total number of respondents was 921. The results show that the income level has a positive impact on respondents' willingness to pay for entry to the Tatra NP. With the increase of fees, the willingness to pay for entry to the Tatra NP decreased by 2.2% for every additional

price increase. The resulting value of the Tatra NP, with the limits of the presented research mentioned in the paper, is approximately 17,5 million €.

The findings from Vrbičanová et al. (2020) show that **mapping cultural ES enables better-informed nature protection and landscape management**. Cultural ES have specific richness and diversity provision patterns related to particular landscape features and land cover forms. Studies of their spatial distribution, however, are quite rare in the Slovak Republic and surrounding countries. The study links land cover information based on an ES matrix, field survey data and GIS method to assess cultural ES supply in two selected Slovak regions (Terchovská Valley micro-region and Horný Liptov Region). One of the results shows that mountainous landscapes in NP have the highest capacity to provide cultural ES (in comparison with other areas without protection).

In conclusion, Slovakia must have sufficient field and database data as well as published methodologies necessary for the **assessment of ES in PA**s, however, they have **not yet been implemented in the PAs context sufficiently.** The above-mentioned publications, which deal with the issue of ES assessment at the national level and regional level, provide evidence of this. Based on the information from these publications as well as other articles, it can be concluded that **PAs contribute significantly to the provision of provisioning, regulatory as well as cultural ES, however, there is a lack of implementation of this concept into policies and practice.**

Poland

State of the Art on a national level

Maczka et al. (2019) in his study observed that many public debates were couched within the ES framework and were descriptive and neutral, with a focus on maintaining the flow of provisioning, regulatory and maintenance services to local communities. Normative tones were adopted, particularly surrounding cultural ES, despite the limited amount of time that stakeholders dedicated to exploring these topics. The study results reinforce the importance of considering the ES concept as a boundary object that maintains interpretive flexibility and focuses stakeholder attention on points of potential social conflict. The **implications** that emerge from this research are particularly **relevant for PAs**, such as those found in Poland, which are reforming environmental protection plans and seeking communication tools to facilitate public participation, environmental sustainability, and more equitable policy outcomes.

An important conclusion of the study by Stępniewska et al. (2018a) stated, that there is a **large potential for the development of ES applications in Poland,** but on the other hand, a **deficit in knowledge** in a practical way and **no wider interest in the ES approach at a regional and local level**, both depend on political decisions. The survey among practitioners helps to identify the main **challenges for ES implementation**. Concerning science, the most important drivers were found to be large ***international research projects***. The **inclusion of** the ES approach in ***strategic documents of the European Union*** was of mobilising importance for the administration.

For a brief summary of the rate of **implementation of ES concept into the Polish legal system** can be used the article from Stępniewska et al. (2018b). An article concludes that the existing law provides space and basis for ES implementation. Perceiving the ecosystems as beneficial for human beings is in Polish regulations, clearly visible in spatial management, nature conservation, forestry, and water management. In the context of ES, the **Nature Conservation Act o**f April 16, 2004 (that describes the rules of legal protection of ecosystems and their elements in Poland) does not use the term “ecosystem services”. However, its objectives, principles and forms of biotic and abiotic nature protection and landscape refer directly to the benefits for people resulting from the functioning of ecosystems. The following table from this study shows the **relations between legally protected natural values and ES** (Fig. 5)

Protected values and corresponding services*	Form of nature conservation									Number of nature conservation forms
	Natura 2000	National Park	Reserve	Landscape Park	Protected Landscape Area	Ecological site	Nature and landscape complex	Documentation site	Natural monument	
Natural values/functions Service: Maintaining nursery populations and habitats	●	●	●	●	●	●			●	7
Cultural values Service: Heritage, cultural		●	●	●					●	4
Historical values Service: Heritage, cultural				●					●	2
Landscape and aesthetic values Aesthetic values		●	●	●	●		●		●	6
Tourism and recreation Service: Physical use of landscapes in different environmental settings					●					1
Didactic/educational value Service: Educational		●		●				●		3
Scientific value Service: Scientific		●	●					●	●	4
Number of protected services	1	5	4	5	3	1	1	2	5	

*According to CICES version 4.3.

Fig. 5 Relations between legally-protected natural values and ES (Stępniewska et al. 2018b).

The relationship between specific ES and different types of conflicts is explored to aid in understanding the barriers to effective biodiversity conservation management (Maczka et al. 2021). Drawing from conflict theory, content analysis is undertaken of public documents generated during consultations about **Natura 2000** management that were conducted in Poland between 2010−2015. Results show the links between **conflict over conservation planning and stakeholders**’ perceptions of potential threats to their access to, and use of, particular ecosystem types. **Cultural and provisioning ES generate more conflict**, with conflict over cultural ES dominating. Conflict over the value of conservation itself was less prevalent, indicating a general agreement about the need for conservation planning. The lack of standardized procedures for reporting on the public consultation process negatively affected institutional memory and limited the opportunities for learning lessons from past mistakes and from good practices.

In the period 2010-2016, Lupa & Stępniewska (2019) led research related to development and **trends in Polish ES** using the content analysis of 84 scientific papers. The results show the ***growing number of publications*** (including papers that refer, apart from theoretical deliberations) ***to case studies related to MAES***. Authors also noticed the increase in the use of primary sources of data, as well as presenting research results based on classifications and terminology recognized internationally, and referring the findings to environmental management issues. The findings also may serve as a discussion on how future directions of the research can be shaped to mainstream ESs into environmental management.

In contrast to the abovementioned study, Tusznio et al. (2018) concluded **key findings about challenges, opportunities, and limitations of the application of ES concept at the local level in Poland**:

- ★ There are urgent challenges to implementing ES at the local level.
- ★ Local-level participatory studies need to recognize the theoretical challenges.
- ★ Participatory mapping is very effective for engaging stakeholders in discussions.
- ★ Numerous limitations need to be considered when involving local representatives.

The nationwide MAES project in Poland was carried out in 2020–2023. The project aimed to increase the scientific capacity of the Polish researchers to develop the ES approach, as well as raise officials' awareness of the potential of ES from the political, social and ecological points of view. Within the project, inter/transdisciplinary research teams formulated relevant indicators for capturing ecological, cultural, and economic values provided by ecosystems typical for the landscape ecological structure of the country. The analysis covers ES provided by agroecosystems, forests, urban ecosystems, freshwaters, marine ecosystems, degraded ecosystems, and ES on the landscape level. The scope of the project includes the selection of relevant ES and their indicators for main ecosystem types in Poland, mapping and assessment of ES on national, regional and local scales, cross-cutting analysis of ecological, cultural and economic values of ES, identification of significant ES synergies, trade-offs and relevant ES bundles. The results were communicated to interested stakeholders through seminars and thematic workshops for administration representatives and expert practitioners. The project results will be summarized in a handbook on ES approach to environmental management (Stępniewska et al, 2018).

State of the Art within/related to PAs

The mapping of ESs in protected areas (PAs) of Europe revealed an increase in studies from 2012 to 2023. Research predominantly focused on terrestrial areas, with most PAs classified as IUCN types II and IV. The Millennium Ecosystem Assessment classification was widely used, emphasizing the supply dimension. Regulating, maintenance, and cultural ES were the most frequently mapped. Common provisioning ES included **animals reared for nutrition** and **cultivated plants** while regulating ES often focused on **habitat maintenance** and **atmospheric regulation**. Cultural ES typically involves **health-promoting activities** and **aesthetic experiences**. Although quantitative approaches

were prevalent, qualitative studies were also significant. The review highlighted a lack of validation in many studies, potentially affecting the credibility of ES mapping in PAs (Kalinauskas et al., 2023).

This study from the Czech Republic explores the perceived **benefits and challenges of Protected Landscape Areas** (PLAs), as well as the potential role of the ES framework in conservation decision-making. Danek et al. (2023) address the gaps by identifying: (1) the perceived benefits (by their managers) that PLAs provide; (2) challenges and trade-offs that PLAs face in delivering these benefits; (3) the role of the ESs framework in PLAs decision-making. They conducted a qualitative analysis of 20 semi-structured interviews with heads of PLAs Administrations in the Czech Republic. Through interviews with PLAs administrators, the researchers found that **cultural and regulating benefits were most frequently mentioned** (Fig 6), with **habitat creation and maintenance being** the single most referenced benefit. The positive and negative themes showed a key role of various types of land-use management (esp. agriculture and forestry) and their enhancing or deteriorating effects on specific benefits (esp. habitat creation and maintenance). All respondents viewed the future **implementation of the ES framework positively,** believing it could **support conservation goal**s and **decision-making in PLAs**. The research provides evidence for the strong societal role of PLAs in safeguarding specific benefits and their crucial function in nature conservation. Additionally, the study demonstrates how the ES framework can illuminate key benefits, challenges, and trade-offs in PLAs.

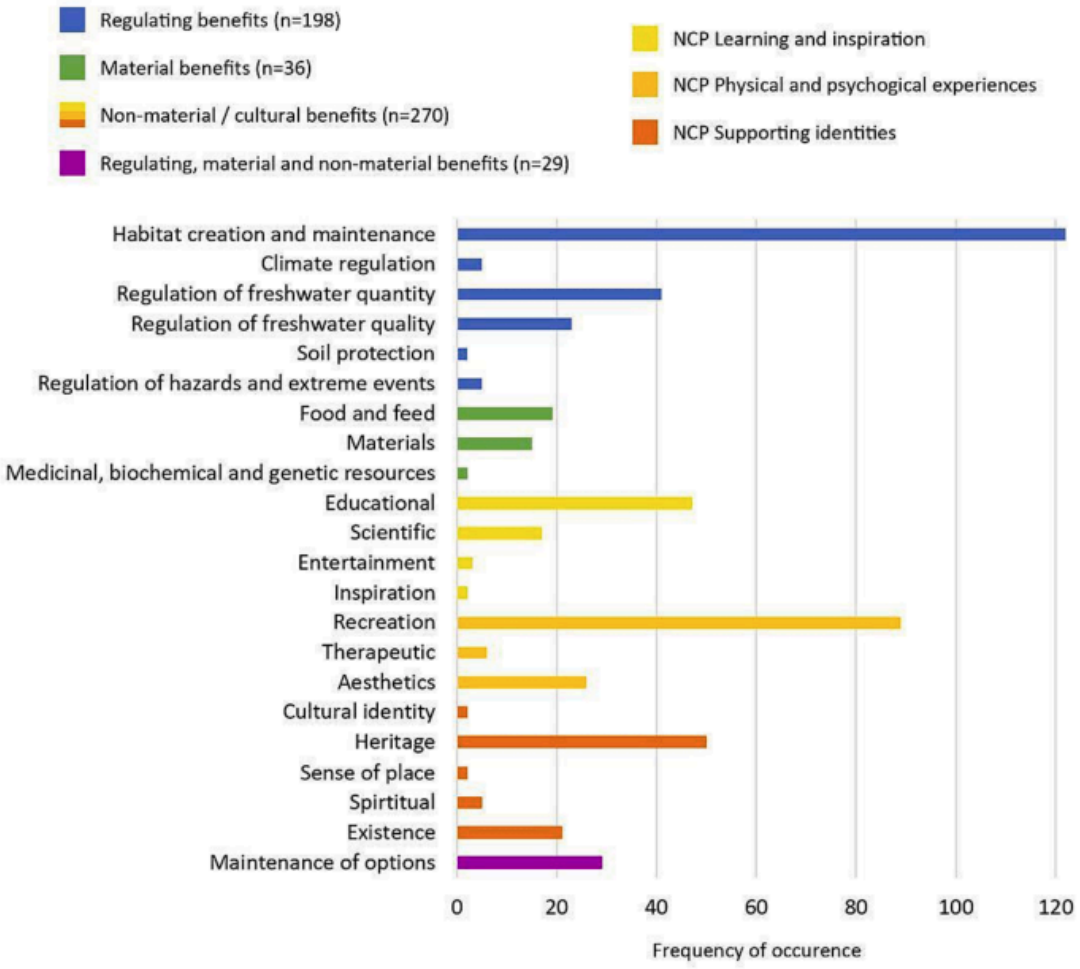

Fig. 6 Summary of all benefits of protected landscape areas coded into specific ES categories as mentioned by respondents in the data set (Danek et al. 2023).

Recent studies have ES mapping and assessment in PAs, with a focus on Poland:

In the study from **Wigry National Park** (Affek & Kowalska, 2017) respondents were asked to detail the frequency of use made of 45 different provisioning and cultural services, and then to evaluate 7 local ecosystem types as regards their capacity to supply 11 groups of services.

A study from **Wielkopolski National Park (WNP**) based on questionnaires led by Zydroń et al. (2021) estimated the variability of perception of the value among different groups of society. Most respondents stated that they would be prepared to pay fees or provide voluntary services to the WNP. Nowadays, because of the advantages of this type of tourism, tourists are usually willing to pay more to enter protected areas. As seen regarding forests or protected areas, the study's findings support the tendency of society's evolution toward a greater attachment to natural, and environmental values, and intangible assets.

Boćkowskiet al. (2024) also used an ecosystem services-driven questionnaire survey to analyze interactions between the perception of ES and opinions about **national parks**. The study was held in the **eastern part of the Polish Carpathian Mountains where Turnicki National Park is planned**. Respondents who perceived benefits from nature were more positive towards national parks in general and the Turnicki National Park specifically; however, those who prioritised provisioning services were more sceptical. Of all the options, respondents most commonly chose benefits of a **material character** as priority services for local wellbeing (52.8% of all choices). Almost 40% of all options were related to **drinking water, heating wood, and gathering plants and animals**. The remaining portion was split between regulatory services (22.5%) and cultural services (24.7%). ***The respondents who were negative towards NP valued provisional ES (57% of all choices)*** more frequently than respondents positive towards NP (48%). Cultural benefits were more important for respondents positive towards the NP (28%), than those with negative stances (21%). The respondents who chose to source wood for non-heating purposes as a key benefit scored significantly lower in terms of approval of Turnicki National Park than respondents who chose habitat for wild pollinators and practising sports, tourism, or recreation.

Sokół & Łaska (2024) in their research from northeastern Poland suggest that **biodiversity conservation** in the catchment is needed for high biodiversity and low-intensity land use. It was found that the river valley catchment provides a range of ES such as the **protection of wetlands, protection of endangered species and ecosystems**, and the presence of **recreational** areas and limits the expansion of built-up areas and develops the ecological system. Biodiversity and ES are mutually beneficial for catchment protection. The spatial results showed that biodiversity and ES show an evident decline with increased land use intensity. The main factor affecting biodiversity is the distance of the river valley sections in the catchment area from the developed space of the city centre. A trade-off for ES and biodiversity is required for most green and agricultural lands with multifunctional benefits and good conditions.

Pietrzyk-Kaszyńska et al., (2022) in their research highlighted the important role of mapping ES in the decision-making processes when different stakeholders are included. It

enables the inclusion of different perspectives, knowledge, needs, or values into decision-making and has already been applied in various contexts. This study explores differences in ES conceptualization and application between conservation experts and local leaders in Poland. Through workshops conducted at five locations involving 100 participants (specialists in the fields of nature conservation and spatial planning, as well as another non-professional local leader), the research found that both groups tend to have convergent views on ES prioritization and reasoning. The study identified three common approaches to mapping ES provisioning areas used by both groups. However, the overlap in resulting maps varied depending on how participants interpreted specific ESs and their mapping approach. Importantly, both conservation professionals and local leaders incorporated factual information and value judgments when applying the ES concept practically. These findings contribute to understanding stakeholder perspectives in ES-based decision-making and highlight the potential for participatory mapping to include diverse viewpoints in conservation and land use planning. The research underscores the importance of stakeholder inclusion in ES-related policy and decision-making processes.

The paper from Affekt et al. (2022) presents methodological solutions to **assess and map urban** ES on a nationwide scale in Poland. All three CICES sections - provisioning, regulatory, and cultural - as well as the three most commonly evaluated service aspects - potential, use, and unmet demand - are covered by the chosen cases. Sample indicators were computed for each of Poland's 20 metropolitan-status functioning urban regions, both overall and in the city centre and commuter zones. Among other things, the findings indicate that the Lublin metropolitan area has the greatest potential for food production. Rzeszów, on the other hand, has the least amount of tree utilization for air filtration. In addition, Częstochowa has a seven-fold greater unmet need for nature-based recreation than Olsztyn. When comparing urban centres and the quality of life of its residents, as well as when developing urban development policies, it can be very helpful to map and evaluate urban ecosystem services nationally, as evidenced by the notable variations in indicator values.

Research has applied **ecosystem accounting principles** to evaluate services like **crop provision, pollination, and nature-based tourism** in the **Sleza Landscape Park** (Sylla, 2024). The work presents an example of ecosystem accounting application at the local level and within a protected landscape. The case study area represents five municipalities that are part of the Sleza Landscape Park in Poland. Three ES (crop provision, pollination, and nature-based tourism) were mapped and attributed to the benefiting sectors. The assessment follows the guidelines of the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA) for recognising the contribution of ecosystem services (ES) to the economy and human well-being. The analysis relates to the years 2014 and 2021 and includes ecosystem extent and flow accounts.

Protected areas, including national parks and Natura 2000 sites, play a crucial role in preserving biodiversity and providing ES that contributes to regional development and human well-being (Getzner, 2010; Kordowska, 2017; Glushkova et al., 2020). These areas offer various ES, such as tourism opportunities like birdwatching, which can be assessed and mapped using methods like the Analytic Hierarchy Process (Kordowska, 2017). The economic value of ES often significantly outweighs the costs of establishing and managing PAs (Getzner, 2010). To evaluate the potential of forest

ecosystems in PAs, researchers use GIS-based methods, process management plan data, and conduct expert assessments (Glushkova et al., 2020). Understanding the relationship between people and nature is essential for effective conservation and sustainable use of ESs (Kordowska, 2017). Proper assessment and mapping of ES can support decision-makers in implementing sustainable management practices for PAs (Glushkova et al., 2020).

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