

## A BIBLIOMETRIC ANALYSIS ON CULTURAL ECOSYSTEM SERVICES ASSESSMENT STUDIES: TRENDS, INSIGHTS AND FUTURE IN A DECADE

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### ABSTRACT

Cultural ecosystem services (CES) refer to intangible benefits derived from human interactions with their surrounding environment, such as recreational opportunities, aesthetic value, cultural heritage, and spiritual value. While attention is increasing towards CES, the growing fragmentation of methodologies, varied geographical distribution, and the lack of standardised assessment remain significant challenges for its integration into urban planning strategies. This paper aims to analyse global research trends in CES assessment and valuation between 2015 and 2025 and to formulate the future direction of CES assessment studies to enhance human-environment interaction. This study employed bibliometric analysis using BiblioMagika and VOSviewer to visualise the recent trends and patterns in CES assessment studies, based on a review of 173 journals from the Scopus database. The findings reveal that CES studies have received considerable academic attention over the decade, especially after 2020, and have mostly come from developed countries such as Germany and the United States, and more recently from China. However, regions with rich biodiversity are still underrepresented, such as Southeast Asia countries. Key themes include social media analysis, participatory spatial mapping, urban green space, and urban green infrastructure, which show their credibility in shifting the world's attention towards urban sustainability.

**Keywords:** Cultural ecosystem services, bibliometric analysis, human-environment interaction, urban planning, sustainable development

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## 1.0 INTRODUCTION

Over the past few decades, the field of environmental psychology has expanded, shifting its focus to the complex interaction between humans and the environment. While initially centred on the influence of external settings on human behaviour, academic interest has expanded to include their impacts on ecological well-being and sustainable environmental planning. This growth led to an increasing emergence in cultural ecosystem services (CES) that can be defined as intangible benefits derived from nature interaction, such as recreational opportunities, spiritual and religious, cultural heritage diversity and sense of place, showing its emphasis in multidisciplinary approaches (Sitas et al., 2015; Hirons et al., 2016).

CES assessment studies provide a vital foundation for advancing the formulated Sustainable Development Goals (SDGs), as they significantly support Goals 3 (Good Health and Well-Being), 11 (Sustainable Cities and Communities), and 15 (Life on Land). Wood et al. (2018) highlighted that effective ecosystem services assessments are needed to tackle environmental challenges while maintaining the flow and trade-offs of the provision of ecosystem services. Despite growing academic interest, the integration of research findings into urban planning is receiving challenges due to the various geographical distributions, the complexities of the

methodology and the lack of standardisation in evaluations (Rózová et al., 2020; Johnson et al., 2019; Gosal et al., 2018; Plieninger et al., 2015). Therefore, a comprehensive review of CES literature is crucial to understand prevailing research trends, identify thematic gaps, and highlight future directions for better planning. Bibliometric analysis serves as a robust tool for systematically identifying these gaps by quantitatively revealing trends, citation patterns, and thematic patterns in CES research over time (Donthu et al., 2021).

This paper aims to conduct a comprehensive review on CES related studies specifically published between 2015 until 2025 and seeks to answer the following research questions: 1) What are the prevailing research trends in CES assessments studies between 2015 and 2025, 2) What are the key thematic of CES assessment studies conducted from 2015 until 2025) and 3) What are the emerging future direction of research in CES that can inform policy development and enhance society well-being?

## **2.0 LITERATURE REVIEW**

### **2.1 Empirical Studies on Cultural Ecosystem Services**

Ecosystem services refer to benefits derived from the interactions between human and natural ecosystems, whether direct or indirect, including provisioning, regulating, supporting, and cultural (MEA, 2000). These services have been central to the development of environmental psychology research, which is expanding knowledge in sustainability science (Chan et al., 2012; Constanza et al., 2017). While provisioning and regulation have received growing attention due to their tangible outcomes, CES capture the intangible benefits such as recreation, cultural heritage, and inspirational and spiritual enrichment. Therefore, by assessing CES values, it offers insights into how people perceive and use value, and how environmental settings influence people's quality of life. Empirical studies on CES have employed various methodological approaches, cultural values and themes to capture the diverse perspectives on the value of CES. For example, Zhang et al. (2021) investigated how the experience of animal-based cultural services is produced through interactions between ecosystem services at cultural heritage sites, thereby enhancing human well-being.

On the other hand, Kokkoris et al. (2020) highlighted the need for localised assessments that capture the diversity of specific ecosystem services to support effective conservation strategies in CES management. Schneider et al. (2024) highlighted the need to prioritise aesthetic and recreational values to improve local tourism, thereby significantly enhancing natural resource management. Additionally, there is growing interest in integrating social preferences into decision-making, underscoring the need for a collaborative approach to CES management strategies (Martin—Lopez et al., Gould et al., 2020). However, despite its global relevance, CES research often focused on developed nations such as Europe, North America, and East Asia, with these regions leading in publication output.

### **2.2 Previous Studies on Bibliometric Analysis in Cultural Ecosystem Services**

Bibliometric analysis offers a systematic tool for examining the intellectual structure, theme evolution, and geographical distribution of research. Through the systematic quantification of publication outputs, citation networks, co-authorship patterns and author keywords, bibliometric analysis illustrates the direction of academic research in the field and identifies its future direction. Global bibliometric analysis of ES began to be driven by the development of the ES framework by MEA (2005) and by efforts to integrate ES research into policy-making strategies. Although early research regarded CES within broader service classification, specialised methodological and conceptual issues of CES have led to the growing literature in the field.

Zhang et al. (2022) conducted a comprehensive review of CES literature from 2005 to 2021, using VOSviewer and CiteSpace, and found that interest in urban green spaces, social media analytics, and participatory mapping is growing in CES research. Liu et al. (2025) investigated the role of CES in human well-being by incorporating bibliometric analysis with content mapping to identify CES values in human health. Similarly, a global review by Chen et al. (2025) assessed CES research in wetland ecosystems by applying systematic review protocols to analyse trends across over 800 studies. These works provide valuable quantitative evidence on integrating cultural values into planning and conservation efforts for environmental settings.

### 3.0 METHODOLOGY

#### 3.1 Search Strategy

The search strategy for identifying literature on cultural ecosystem service assessment studies is illustrated in Figure 1, a flow diagram that explains the methodological framework of the study and demonstrates the systematic procedures used to retrieve the most relevant literature for article analysis to achieve the objectives formulated in this paper. Scopus was selected as the primary database for this analysis due to its extensive coverage across multidisciplinary fields and its high-quality, reliable data, which make it a robust tool for analysing and visualising research outputs.

To enhance search accuracy and ensure results are relevant, the search field was limited to article titles, thereby capturing only evidence-based studies of cultural ecosystem services. The search was conducted over 10 years, from 2015 to 2025, to reflect the evolution of the relevant literature over that period. Additionally, only the English language was used in the filter search to make it suitable for later data analysis. To ensure academic content only, the search was further refined to include journal articles that advance both theoretical and practical knowledge.

A detailed search string was developed using the keywords "cultural ecosystem service\*", "urban green space\*" and "assessment\*" to capture exact matches. Boolean operators were applied to exclude irrelevant document types and optimise exclusivity. The data extraction was conducted on 5 June 2025, and a total of 495 articles were identified and screened for inclusion, providing a robust foundation for the later bibliometric evaluation. Manual searching was conducted using predefined criteria to ensure the eligibility of the preliminary data analysis. The inclusion criteria were as follows: 1) Should focus on cultural ecosystem services only, 2) CES assessment studies should be conducted in green space settings only, and 3) employ any assessment methods or techniques. As a result, 173 articles were selected and downloaded for a preliminary data analysis using the BiblioMagika worksheet.

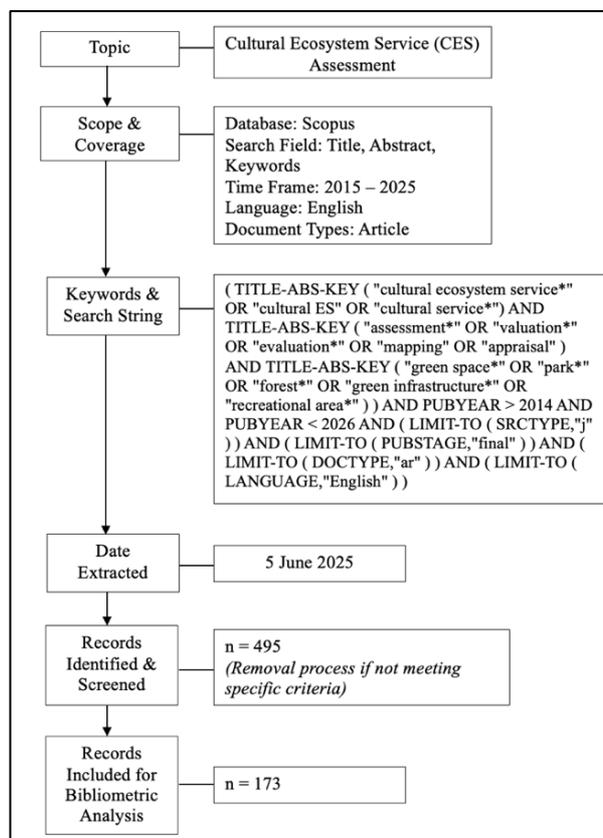


Fig. 1: Flow diagram of the search strategy

### 3.2 Data Cleaning, Harmonisation and Tools

To ensure the accuracy and reliability of the data, thorough data cleaning and harmonisation were conducted using the advanced functionalities of biblioMagika and OpenRefine. This step is critical to ensuring data validity, and only relevant articles were included in the network analysis using VOSviewer. BiblioMagika was developed by Ahmi (2024) exclusively for data harmonisation, providing greater transparency by systematically cleansing and organising data extracted from the Scopus database. The initial phase began by downloading the Scopus data in CSV format and conducting a thorough review of key columns, including author names, affiliations, author keywords, and country. Advanced clustering techniques were employed to detect inconsistencies, and corrections were made to standardise the output, thereby retaining the integrity of the data after segmentation. Once cleaned, the dataset was reverted to its original format structure for further analysis.

For the next analysis phase, BiblioMagika was utilised to enhance the bibliometric analysis by standardising metadata on authorship, affiliations, and countries. OpenRefine was used to support the effort to refine keyword data by splitting multi-cell data, and a variety of clustering techniques helped expedite the process. Network visualisation was generated using VOSviewer to generate a conceptual network map. This integrated multi-tool approach enabled a comprehensive, structured analysis of research trends, particularly in the field of cultural ecosystem services.

## 4.0 DATA ANALYSIS AND DISCUSSION

### 4.1 Document Profile

Table 1 provides an overview of the final documents retrieved from the Scopus database and used in the preliminary data analysis. In the period from 2015 to 2025, a total of 173 publications by 750 contributing authors were identified, focusing exclusively on cultural ecosystem service assessment studies in green space settings. A total of 5,574 citations were received over the period, corresponding to an overall h-index of 46, reflecting the research's publication impact and citation performance within the field.

**Table 1:** Main information and subject area  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

| Main Information               | Data        | Subject Area                                 | TP  | %      |
|--------------------------------|-------------|----------------------------------------------|-----|--------|
| Publication Years              | 2015 - 2025 | Environmental Science                        | 147 | 84.97% |
| Total Publications             | 173         | Agricultural and Biological Sciences         | 85  | 49.13% |
| Citable Year                   | 11          | Social Sciences                              | 71  | 41.04% |
| Number of Contributing Authors | 750         | Decision Sciences                            | 16  | 9.25%  |
| Number of Cited Papers         | 154         | Energy                                       | 15  | 8.67%  |
| Total Citations                | 5,574       | Computer Science                             | 10  | 5.78%  |
| Citation per Paper             | 32.22       | Earth and Planetary Sciences                 | 9   | 5.20%  |
| Citation per Cited Paper       | 36.19       | Business, Management and Accounting          | 7   | 4.05%  |
| Citation per Year              | 557.40      | Economics, Econometrics and Finance          | 7   | 4.05%  |
| Citation per Author            | 7.43        | Engineering                                  | 6   | 3.47%  |
| Author per Paper               | 4.34        | Chemical Engineering                         | 2   | 1.16%  |
| Citation sum within h-Core     | 5,303       | Medicine                                     | 2   | 1.16%  |
| h-index                        | 46          | Arts and Humanities                          | 1   | 0.58%  |
| g-index                        | 69          | Biochemistry, Genetics and Molecular Biology | 1   | 0.58%  |
| m-index                        | 4.182       | Health Professions                           | 1   | 0.58%  |
|                                |             | Materials Science                            | 1   | 0.58%  |
|                                |             | Mathematics                                  | 1   | 0.58%  |
|                                |             | Multidisciplinary                            | 1   | 0.58%  |
|                                |             | Pharmacology, Toxicology and Pharmaceutics   | 1   | 0.58%  |
|                                |             | Physics and Astronomy                        | 1   | 0.58%  |

Additionally, by recognising which subject area acknowledges cultural ecosystem service assessment studies, we can determine a current trend within the field, as shown in Table 1—the distribution of publications that show the multidisciplinary interests spanning social, technological, and economic domains. There are three dominant subject areas, with almost 85% of publications falling under Environmental Science, reflecting its strong focus on ecosystems, biodiversity, landscape management, and environmental planning as key elements of CES studies. Other than that, Agricultural and Biological with 49.1% and Social Sciences at 41.04% show significant focus on land-use planning and human-based studies.

### 4.2 Publication Trends

Table 2 provides information on temporal patterns in cultural ecosystem service assessment studies, reflecting a steady, accelerating growth trajectory in both the number of publications and citations over the decade.

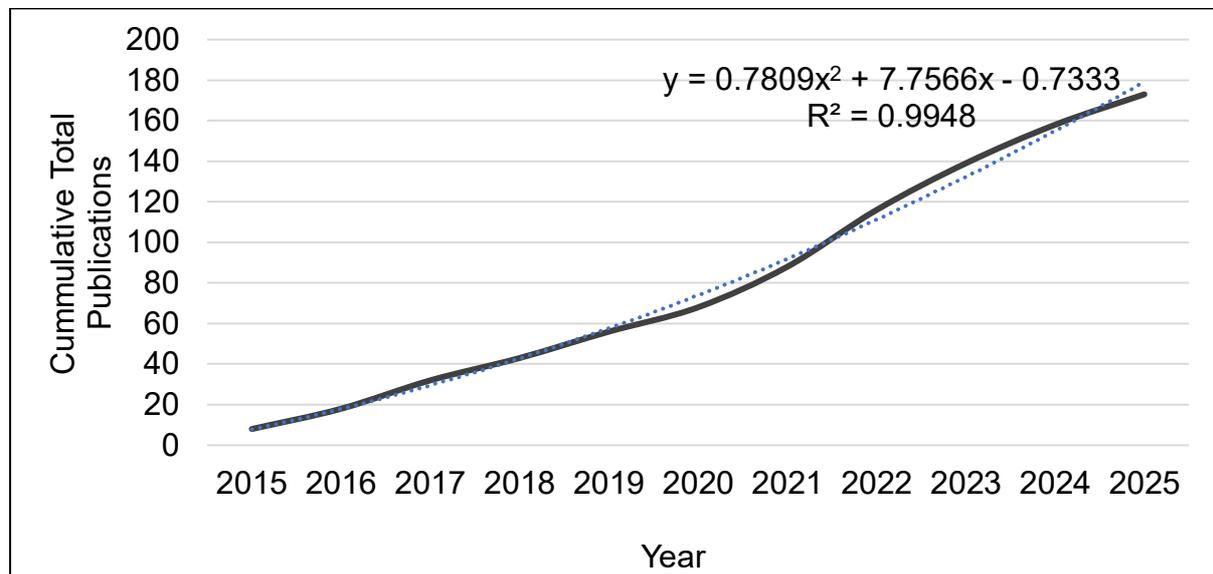
Between 2015 and 2025, academic research increased significantly, with cumulative publications rising from less than 10 in 2015 to over 170 by 2025. The Total Citations (TC) data reveal a substantial rise in 2020, in which 611 citations were recorded as the highest citation count thus far, surpassing the preceding years (2017 – 2019), demonstrating growing scholarly influence and recognition of CES during the time.

Figure 2 illustrates the polynomial trend line ( $R^2 = 0.9948$ ), which shows a clear, strong increase in academic performance for CES studies during this period. Average citations per publication (C/P) indicate that earlier publications received higher average citation rates, suggesting their impact as early foundation studies in CES research.

**Table 2:** Annual research output and citation metrics  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

| Year  | TP  | NCA | NCP | TC   | C/P   | C/CP  | h  | g  | m     |
|-------|-----|-----|-----|------|-------|-------|----|----|-------|
| 2015  | 8   | 45  | 8   | 696  | 87.00 | 87.00 | 8  | 8  | 0.727 |
| 2016  | 10  | 44  | 10  | 533  | 53.30 | 53.30 | 8  | 10 | 0.800 |
| 2017  | 14  | 59  | 14  | 1186 | 84.71 | 84.71 | 14 | 14 | 1.556 |
| 2018  | 11  | 58  | 11  | 815  | 74.09 | 74.09 | 11 | 11 | 1.375 |
| 2019  | 13  | 58  | 13  | 611  | 47.00 | 47.00 | 12 | 13 | 1.714 |
| 2020  | 12  | 51  | 12  | 468  | 39.00 | 39.00 | 9  | 12 | 1.500 |
| 2021  | 20  | 73  | 19  | 472  | 23.60 | 24.84 | 12 | 20 | 2.400 |
| 2022  | 28  | 115 | 28  | 482  | 17.21 | 17.21 | 13 | 21 | 3.250 |
| 2023  | 23  | 93  | 21  | 243  | 10.57 | 11.57 | 11 | 14 | 3.667 |
| 2024  | 19  | 93  | 15  | 60   | 3.16  | 4.00  | 5  | 6  | 2.500 |
| 2025  | 15  | 61  | 3   | 8    | 0.53  | 2.67  | 2  | 2  | 2.000 |
| Total | 173 | 750 | 154 | 5574 | 32.22 | 36.19 | 46 | 69 | 4.182 |

Notes: TP = total number of publications; NCA = Number of contributing authors; NCP = number of cited publications; TC = total citations; C/P = average citations per publications; C/CP = average citations per cited publication; h = h-index; g = g-index; m = m-index



**Fig. 2:** Cumulative growth of publications  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

A significant peak in annual publication volume was observed in 2022, with 28 publications, followed by consistently high numbers in 2023 (23 publications) and 2024 (19 publications). This upward trend shows growing momentum in CES research, potentially driven by efforts to integrate the CES concept into sustainable development planning, sustainability frameworks, and ecosystem management initiatives. Meanwhile, Figure 3 illustrates the citation trend, with the highest total citations recorded in 2017 (1,186), reflecting the influential impact of earlier foundation studies, followed by 2018 (815) and 2019 (611). However, total citation counts are decreasing significantly, with only 60 citations in 2024 and 8 in 2025, suggesting a citation lag.



**Fig. 3:** Total publications and total citations by year  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

Bibliometric indices such as the h-index, g-index, and m-index systematically provide important insights into the quality, impact, and citation dynamics of CES research during this period. The h-index measures productivity and citation impact and shows a progressive increase, reaching a high of 15 in 2021. This method reflects the cumulative influence and consistency of CES publications. The g-index indicates highly cited publications, and the value recorded shows that the top-cited articles collectively received at least 729 citations, which drives most scholarly attention in CES research. The m-index measures the citation rate relative to an academic's age by dividing the h-index by the number of years since the first publication. A moderate yet upward trend in the m-index suggests consistent citation growth over time in CES research.

### 4.3 Publication by Authors

Table 3 presents a systematic bibliometric analysis of the highest contributors in the field, focusing on cultural ecosystem services research, by calculating the total publication volume and the impact of individual researchers using citation-based metrics.

**Table 3:** Most productive author  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

| Full Name               | Current Affiliation         | Country        | TP | NCP | TC  | C/P   | C/CP  | h | g | m     |
|-------------------------|-----------------------------|----------------|----|-----|-----|-------|-------|---|---|-------|
| Pereira, Paulo          | Mykolas Romeris University  | Lithuania      | 5  | 5   | 251 | 50.20 | 50.20 | 5 | 5 | 0.556 |
| Semmens, Darius J.      | United States Geological I  | United States  | 4  | 4   | 254 | 63.50 | 63.50 | 4 | 4 | 0.444 |
| Sherrouse, Benson C.    | United States Geological I  | United States  | 4  | 4   | 254 | 63.50 | 63.50 | 4 | 4 | 0.444 |
| Ancona, Zachary H.      | United States Geological I  | United States  | 4  | 4   | 254 | 63.50 | 63.50 | 4 | 4 | 0.444 |
| Inácio, Miguel          | Mykolas Romeris University  | Lithuania      | 3  | 3   | 109 | 36.33 | 36.33 | 3 | 3 | 0.600 |
| Grilli, Gianluca        | University of Florence      | Italy          | 3  | 3   | 66  | 22.00 | 22.00 | 3 | 3 | 0.273 |
| Sacchelli, Sandro       | University of Florence      | Italy          | 3  | 3   | 69  | 23.00 | 23.00 | 3 | 3 | 0.429 |
| Haase, Dagmar           | Humboldt-Universität zu B   | Germany        | 3  | 2   | 193 | 64.33 | 96.50 | 2 | 3 | 0.222 |
| Kalinauskas, Marius     | Mykolas Romeris University  | Lithuania      | 3  | 3   | 109 | 36.33 | 36.33 | 3 | 3 | 0.600 |
| Gomes, Eduardo          | Mykolas Romeris University  | Lithuania      | 3  | 3   | 109 | 36.33 | 36.33 | 3 | 3 | 0.600 |
| Vuletić, Djana          | Croatian Forest Research    | Croatia        | 2  | 1   | 13  | 6.50  | 13.00 | 1 | 2 | 0.250 |
| Ciesielski, Mariusz     | Forest Research Institute   | Poland         | 2  | 1   | 1   | 0.50  | 1.00  | 1 | 1 | 0.333 |
| Yu, Tao                 | Affiliation NA              | China          | 2  | 2   | 15  | 7.50  | 7.50  | 2 | 2 | 0.667 |
| Tian, Tian              | East China Normal Univers   | China          | 2  | 2   | 21  | 10.50 | 10.50 | 2 | 2 | 0.667 |
| Kičić, Martina          | Croatian Forest Research    | Croatia        | 2  | 1   | 13  | 6.50  | 13.00 | 1 | 2 | 0.250 |
| Deng, Lingzhi           | Affiliation NA              | China          | 2  | 2   | 21  | 10.50 | 10.50 | 2 | 2 | 0.667 |
| Krajter Ostoić, Silvija | Humboldt-Universität zu B   | Germany        | 2  | 1   | 13  | 6.50  | 13.00 | 1 | 2 | 0.250 |
| Che, Yue                | University of California    | United States  | 2  | 2   | 21  | 10.50 | 10.50 | 2 | 2 | 0.667 |
| Kovács, Barbara         | National Polytechnic Instit | Mexico         | 2  | 2   | 17  | 8.50  | 8.50  | 2 | 2 | 0.400 |
| Wang, Peng              | Research Institute of Fore  | China          | 2  | 2   | 14  | 7.00  | 7.00  | 1 | 2 | 0.250 |
| Li, Nan                 | Economic Research Institu   | China          | 2  | 2   | 14  | 7.00  | 7.00  | 1 | 2 | 0.250 |
| Correia, Ricardo A.     | University of Oxford        | United Kingdom | 2  | 2   | 117 | 58.50 | 58.50 | 2 | 2 | 0.250 |
| Barbierato, Elena       | University of Florence      | Italy          | 2  | 2   | 37  | 18.50 | 18.50 | 2 | 2 | 0.333 |
| Baral, Himlal           | Center for International Fo | Indonesia      | 2  | 2   | 108 | 54.00 | 54.00 | 2 | 2 | 0.250 |
| Dai, Peichao            | China University of Mining  | China          | 2  | 2   | 71  | 35.50 | 35.50 | 2 | 2 | 0.286 |

Notes: TP = total number of publications; NCA = Number of contributing authors; NCP = number of cited publications; TC = total citations; C/P = average citations per publications; C/CP = average citations per cited publication; h = h-index; g = g-index; m = m-index

Data such as Total Publications (TP), Total Citations (TC), and Citations per Cited Publication (C/CP) were highlighted to assess scholarly influence and its impact within the academic community. Table 4 indicates that Paulo Pereira from Mykolas Romeris University (Lithuania) is the most productive author, having contributed five publications to CES research, with the highest h-index (5) and m-index (0.556) among all contributors. Besides that, a notable group from the United States Geological Survey (Semmens, Sherrouse, and Ancona) followed with four publications each, demonstrating their prominent role in advancing CES methodologies and valuation frameworks.

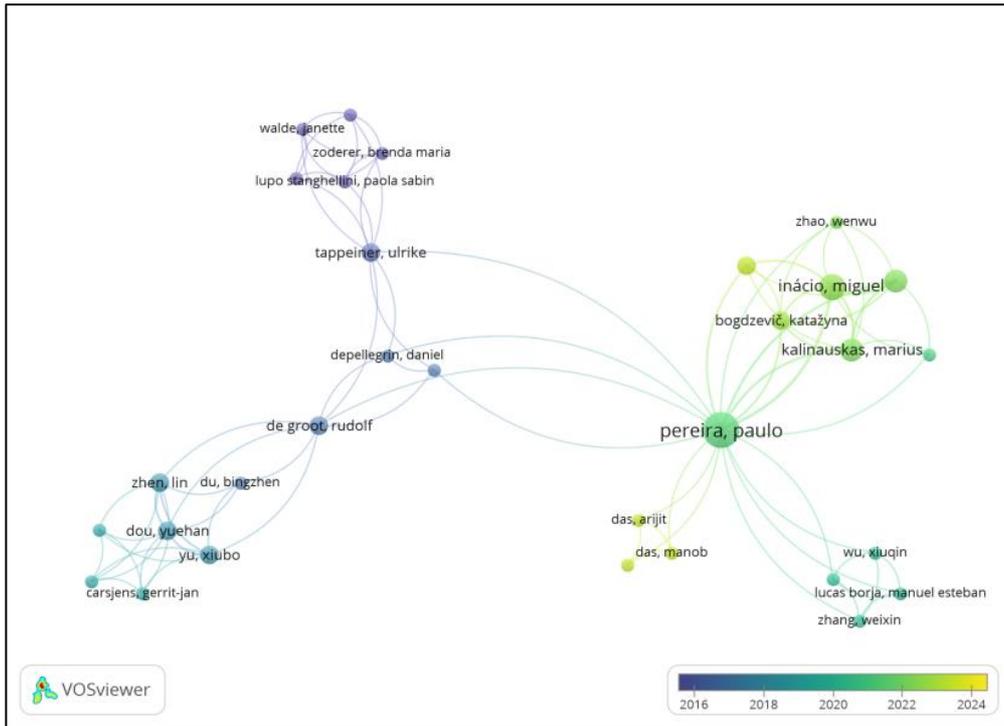
Table 4 presents the citation influence of each author, thus indicating that a few authors report exceptionally high C/P and C/CP values ranging from 112 to 196 despite a small number of publications. The highest total citation counts are tied among Semmens, Sherrouse, Ancona, and Pereira, each with 254–251 citations, reflecting highly cited and impactful work. Daniel R. Richards, Bige Tunçer, and Rudolf de Groot recorded exceptionally high C/P and C/CP values of 112-196, demonstrating research impact through widespread citation despite fewer publications. The analysis reveals a diverse but geographically concentrated field, with authors from Europe and North America dominating both publication output and citation performance.

**Table 4:** Most influential authors by total citation  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

| Full Name              | Current Affiliation                           | Country       | TP | NCP | TC  | C/P    | C/CP   | h | g | m     |
|------------------------|-----------------------------------------------|---------------|----|-----|-----|--------|--------|---|---|-------|
| Ancona, Zachary H.     | United States Geological Survey               | United States | 4  | 4   | 254 | 63.50  | 63.50  | 4 | 4 | 0.444 |
| Sherrouse, Benson C.   | United States Geological Survey               | United States | 4  | 4   | 254 | 63.50  | 63.50  | 4 | 4 | 0.444 |
| Semmens, Darius J.     | United States Geological Survey               | United States | 4  | 4   | 254 | 63.50  | 63.50  | 4 | 4 | 0.444 |
| Pereira, Paulo         | Mykolas Romeris University                    | Lithuania     | 5  | 5   | 251 | 50.20  | 50.20  | 5 | 5 | 0.556 |
| De Groot, Rudolf       | Wageningen University and Research            | Netherlands   | 2  | 2   | 224 | 112.00 | 112.00 | 2 | 2 | 0.222 |
| Tappeiner, Ulrike      | University of Innsbruck                       | Italy         | 2  | 2   | 198 | 99.00  | 99.00  | 2 | 2 | 0.200 |
| Tunçer, Bige           | Singapore University of Technology and Design | Singapore     | 1  | 1   | 196 | 196.00 | 196.00 | 1 | 1 | 0.125 |
| Richards, Daniel R.    | Singapore University of Technology and Design | Singapore     | 1  | 1   | 196 | 196.00 | 196.00 | 1 | 1 | 0.125 |
| Dou, Yuehan            | Wageningen University and Research            | Netherlands   | 2  | 2   | 193 | 96.50  | 96.50  | 2 | 2 | 0.222 |
| Zhen, Lin              | University of Chinese Academy of Sciences     | China         | 2  | 2   | 193 | 96.50  | 96.50  | 2 | 2 | 0.222 |
| Haase, Dagmar          | Humboldt-Universität zu Berlin                | Germany       | 3  | 2   | 193 | 64.33  | 96.50  | 2 | 3 | 0.222 |
| Yu, Xiubo              | University of Chinese Academy of Sciences     | China         | 2  | 2   | 193 | 96.50  | 96.50  | 2 | 2 | 0.222 |
| Hiura, Tsutomu         | Hokkaido University                           | Japan         | 1  | 1   | 182 | 182.00 | 182.00 | 1 | 1 | 0.111 |
| Yoshimura, Nobuhiko    | Hokkaido University                           | Japan         | 1  | 1   | 182 | 182.00 | 182.00 | 1 | 1 | 0.111 |
| Bieling, Claudia       | University of Hohenheim                       | Germany       | 1  | 1   | 180 | 180.00 | 180.00 | 1 | 1 | 0.111 |
| Rall, Emily            | Technische Universität München                | Germany       | 1  | 1   | 180 | 180.00 | 180.00 | 1 | 1 | 0.111 |
| Zytynska, Sharon       | Technische Universität München                | Germany       | 1  | 1   | 180 | 180.00 | 180.00 | 1 | 1 | 0.111 |
| Calvet-Mir, Laura      | Universitat Autònoma de Barcelona             | Spain         | 2  | 2   | 172 | 86.00  | 86.00  | 2 | 2 | 0.200 |
| Whelan, Christopher J. | University of Illinois                        | United States | 1  | 1   | 166 | 166.00 | 166.00 | 1 | 1 | 0.091 |
| Westphal, Lynne M.     | Northwestern Research Station                 | United States | 1  | 1   | 166 | 166.00 | 166.00 | 1 | 1 | 0.091 |
| Belaire, J. Amy        | University of Illinois at Chicago             | United States | 1  | 1   | 166 | 166.00 | 166.00 | 1 | 1 | 0.091 |
| Minor, Emily S.        | University of Illinois at Chicago             | United States | 1  | 1   | 166 | 166.00 | 166.00 | 1 | 1 | 0.091 |
| Baró, Francesc         | Universitat Autònoma de Barcelona             | Spain         | 2  | 2   | 155 | 77.50  | 77.50  | 2 | 2 | 0.182 |
| Langemeyer, Johannes   | Universitat Autònoma de Barcelona             | Spain         | 2  | 2   | 155 | 77.50  | 77.50  | 2 | 2 | 0.182 |
| Gómez-Baggethun, Erik  | Universitat Autònoma de Barcelona             | Spain         | 1  | 1   | 136 | 136.00 | 136.00 | 1 | 1 | 0.091 |

Notes: TP = total number of publications; NCA = Number of contributing authors; NCP = number of cited publications; TC = total citations; C/P = average citations per publications; C/CP = average citations per cited publication; h = h-index; g = g-index; m = m-index

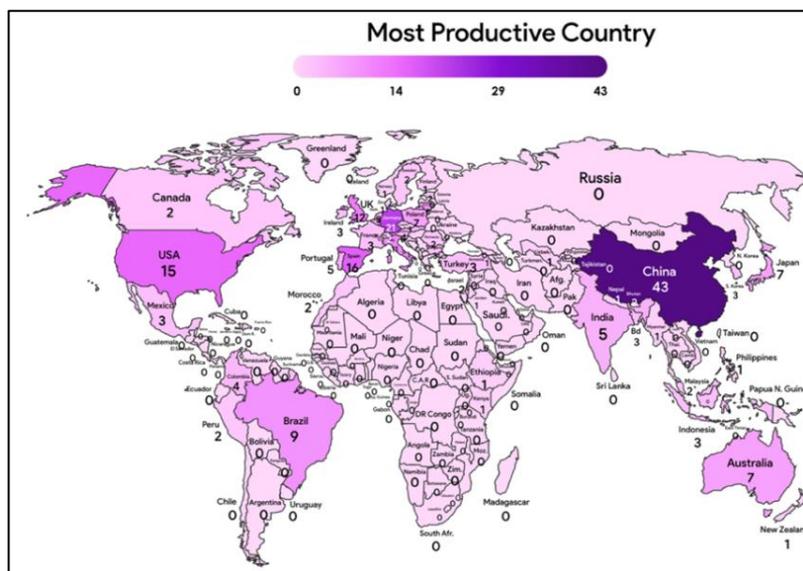
Figure 4 illustrates an overlay network co-authorship network visualisation generated by VOSviewer, mapping the collaboration of authors in publishing research in the context of CES research. This network visualisation uses a temporal colour scale (from dark blue = older collaborations to yellow = recent collaborations) to show how collaboration patterns have evolved. Based on the network visualisation, it is notable that Paulo Pereira is the most dominant node, aligning with the record as the most productive author, and he is directly linked to multiple co-authors, including Miguel Inacio, Katazyna Bogdsevic, Marius Kalinauskas, and Wenwu Zhao, forming a highly active and growing collaborative network. Figure 4 shows the recent evolution of the co-authorship network in CES research, from Rudolf de Groot, who played a foundational role in earlier years, highlighting the transition in leadership and collaboration over time.



**Fig. 4:** Overlay visualisation of the co-authorship network based on the number of documents

#### 4.4 Publication by Countries

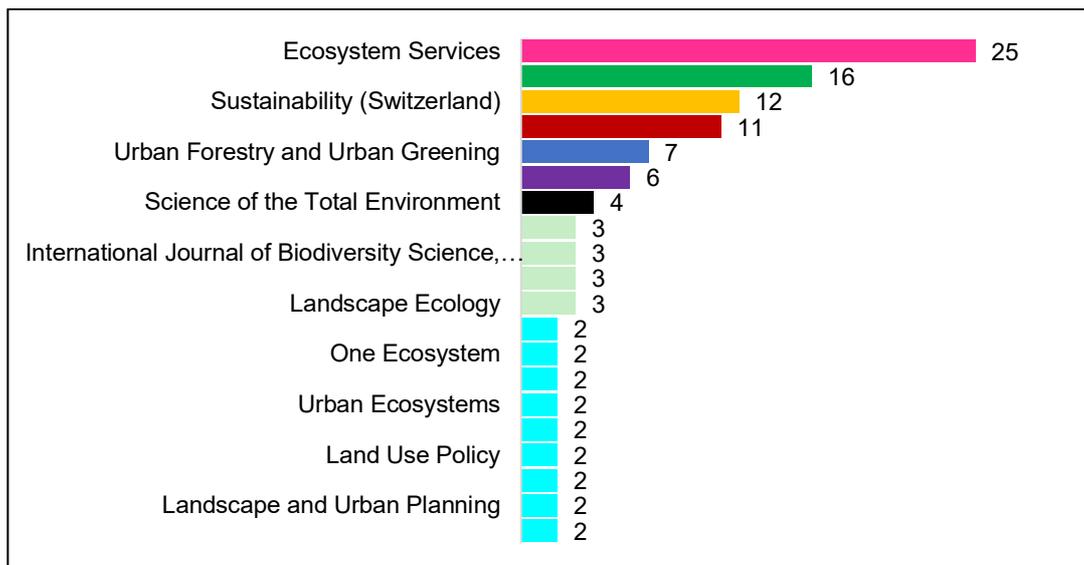
The data in Figure 5 reveals that China is the top contributor in the field with 43 publications, 861 total citations and the highest h-index of 15, reflecting its recent growing prominence in CES-related publications, followed by Germany with 21 publications and the highest total citation count (TC = 936), showing its strong citation impact in Europe. Spain, the United States and the United Kingdom represent Western countries that show substantial publications with 16, 15 and 12 publications respectively, making strong contributions and consistent citation metrics. However, Southeast Asia remains relatively underrepresented, with India, which recorded five publications, showing low citation performance ( $C/P = 14.20$ ). Despite being home to rich biodiversity and diverse cultural ecosystems, Bangladesh, Indonesia, and Malaysia each contributed only three publications to the CES field, underscoring significant underrepresentation in global research. Based on this analysis, there is a lack of representation of CES research across much of Africa, the Middle East, and Central Asia, which might reduce opportunities for integrating nature-culture interdependencies.



**Fig. 5:** Distribution of country production in CES assessment studies

#### 4.5 Publication by Source Titles

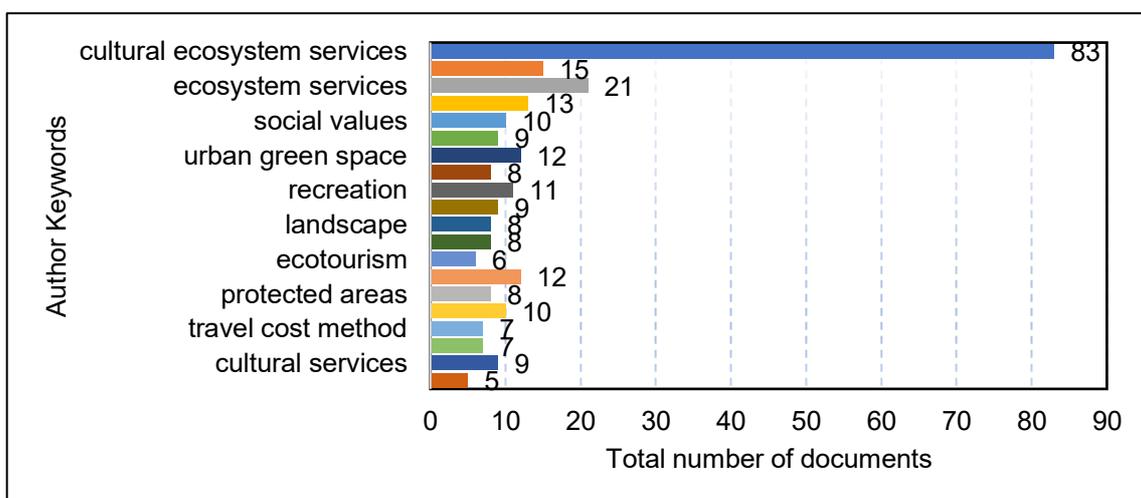
Figure 6 illustrates the scholarly journals that serve as the most active venues for CES assessment studies and lists the top 20 journals by publication frequency, highlighting their role as platforms for disseminating knowledge about CES research across multidisciplinary studies. The top journal is *Ecosystem Services*, with 25 publications, underscoring its role as the primary platform for CES research and its alignment with the field's core themes, such as ecosystem services valuation. This method is further followed by *Ecological Indicators* (16 publications), which highlight sub-topics such as spatial mapping, sustainability indicators and quantitative tools. Other than that, urban-focused areas such as *Urban Forestry*, *Urban Greening*, and *Urban Ecosystems* demonstrate the relevance of CES research to urban resilience, urban green space planning, and urban management. This publication data shows the interdisciplinary nature of CES research, which intersects with a broad range of disciplines and application areas.



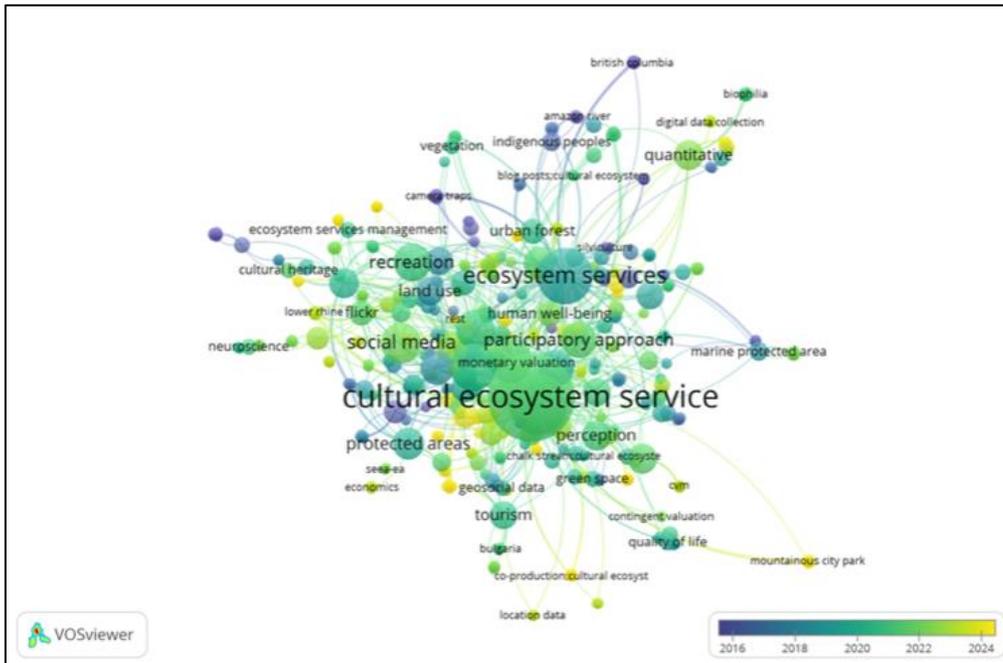
**Fig. 6:** Top 20 most productive source titles  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))

#### 4.6 Author Keywords

Figure 7 presents the frequency analysis of author keywords associated with the CES assessment studies as the dominant keywords that represent the core theme of the analysis. Keywords such as "ecosystem services", "social value" and "social media" are among the related keywords indicating the growing integration of public participation methods into studies of urban cultural ecosystem services.

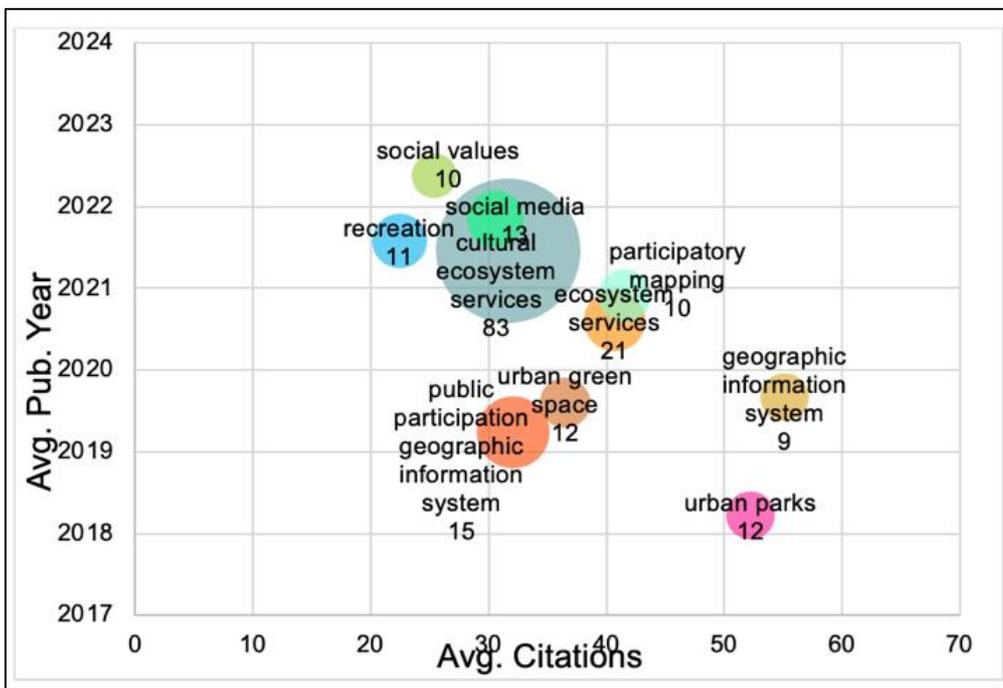


**Fig. 7:** Frequency of author keywords by total link strength  
(Source: Generated by the author(s) using biblioMagika® (Ahmi, 2024))



**Fig. 8:** Overlay network visualisation on author keywords

According to the temporal and citation impact analysis illustrated in Figure 8, these keywords began receiving attention from researchers in 2020. Figure 9 illustrates the overlay network visualisation generated in VOSviewer, where node colours represent the average publication year. The central cluster emerging from terms such as "cultural ecosystem service", "ecosystem services", "participatory approach", "recreation" and "protected area" that are frequently co-occurring, highly cited, and widely incorporated across multidisciplinary studies.



**Fig. 9:** Temporal and citation impacts of author keywords

## 5.0 CONCLUSION

The bibliometric analysis of CES research from 2015 to 2025 shows substantial growth in the field, though studies from developed countries and Southeast Asian countries remain underrepresented despite their rich cultural diversity. Current research themes focusing on urban green space, participatory mapping and social value highlight the role of CES research in urban planning strategies. Moving forward, CES research should prioritise the standardisation of methodological approaches to enable cross-study comparison, increase empirical research, and capture diverse perspectives, thereby fostering interdisciplinary collaboration among stakeholder groups that should inform decision-makers, local authorities, and communities in the formulation of sustainable urban planning strategies.

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## REFERENCES

- Ahmi, A (2024). biblioMagika®. <https://bibliomagika.com/>
- Chan, K. M. A., Satterfield, T., & Goldstein, J. (2012). Rethinking ecosystem services to better address and navigate cultural values. *Ecological Economics*, 74, 8–18. <https://doi.org/10.1016/j.ecolecon.2011.11.011>
- Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., ... & Grasso, M. (2017). Twenty years of ecosystem services: How far have we come and how far do we still need to go? *Ecosystem Services*, 28, 1–16. <https://doi.org/10.1016/j.ecoser.2017.09.008>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: an overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Gould, R. K., Adams, A., & Vivanco, L. A. (2020). Looking into the dragons of cultural ecosystem services. *Ecosystems and People*, 16(1), 257–272. <https://doi.org/10.1080/26395916.2020.1815841>
- Gosal, A., Newton, A., & Gillingham, P. (2018). Comparison of methods for a landscape-scale assessment of the cultural ecosystem services associated with different habitats. *International Journal of Biodiversity Science Ecosystems Services & Management*, 14(1), 91–104. <https://doi.org/10.1080/21513732.2018.1447016>
- Hirons, M., Combetti, C., & Dunford, R. W. (2016). Valuing cultural ecosystem services. *Annual Review of Environment and Resources*, 41(1), 545–574. <https://doi.org/10.1146/annurev-environ-110615-085831>
- Johnson, M., Campbell, L., Svendsen, E., & McMillen, H. (2019). Mapping urban park cultural ecosystem services: a comparison of Twitter and semi-structured interview methods. *Sustainability*, 11(21), 6137. <https://doi.org/10.3390/su11216137>
- Kokkoris, I., Mallinis, G., Bekri, E. S., Vlami, V., Zogaris, S., Chrysaifis, I., ... & Dimopoulos, P. (2020). National set of maes indicators in Greece: ecosystem services and management implications. *Forests*, 11(5), 595. <https://doi.org/10.3390/f11050595>
- Martín-López, B., Iñiesta-Arandía, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., García-del-Amo, D., ... & Montes, C. (2012). Uncovering ecosystem service bundles through social preferences. *PLoS ONE*, 7(6), e38970. <https://doi.org/10.1371/journal.pone.0038970>
- Millennium Ecosystem Assessment (MEA). (2005). *Ecosystems and human well-being: Synthesis*. Island Press.
- Plieninger, T., Bieling, C., Fagerholm, N., Byg, A., Hartel, T., Hurley, P., ... & Huntsinger, L. (2015). The role of cultural ecosystem services in landscape management and planning. *Current Opinion in Environmental Sustainability*, 14, 28–33. <https://doi.org/10.1016/j.cosust.2015.02.006>
- Rózová, Z., Turanovičová, M., & Stašová, S. (2020). Recreation in the city is a part of cultural ecosystem services. *Ekológia (Bratislava)*, 39(2), 190–200. <https://doi.org/10.2478/eko-2020-0014>
- Sitas, N., Prozesky, H., Esler, K. J., & Reyers, B. (2015). Exploring the gap between ecosystem service research and management in development planning. *Urban Ecology*, 21–52. <https://doi.org/10.1201/b18713-4>
- Schneider, J., Pechancová, E., & Zourková, I. (2024). Cultural ecosystem services of the traditional South Bohemian landscape on the example of the Labe Třeboňsko. *Proceedings of the 15th Conference Public Recreation and Landscape Protection - With Environment Hand in Hand!*. <https://doi.org/10.11118/978->

80-7509-963-1-0034

- Wood, S., Jones, S., Johnson, J., Brauman, K., Chaplin-Kramer, R., Fremier, A., ... & DeClerck, F. (2018). Distilling the role of ecosystem services in the Sustainable Development Goals. *Ecosystem Services*, 29, 70–82. <https://doi.org/10.1016/j.ecoser.2017.10.010>
- Zhang, Y., Lee, T. J., & Xiong, Y. (2021). The contribution of animal-based cultural ecosystem services to tourist well-being at cultural heritage sites. *Journal of Travel Research*, 61(7), 1631-1647. <https://doi.org/10.1177/00472875211037743>