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A BIBLIOMETRIC ANALYSIS OF MARINE SPATIAL PLANNING RESEARCH USING VOSVIEWER

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ABSTRACT

Marine / Maritime Spatial Planning (MSP) should be implemented to effectively regulate the activities carried out in the seas and to reduce pressures on the marine area by rationally managing natural resources. A quantitative analysis of scientific research on marine spatial planning is essential to fill critical knowledge gaps in the field, guide the development of appropriate policies and strategies, and strengthen the practice of sustainable marine spatial management. The aim of this study is to conduct a bibliometric analysis of the literature on the concept of marine spatial planning. The research was performed searching for the string "marine spatial planning" or "maritime spatial planning" on documents title, abstract and keywords. The first study on MSP was published in 2006. Until 2024, 1,654 publications on MSP were published. The number of publications per year showed an increasing trend throughout the research period. The journal 'Marine Policy' establishes itself as the premier source for MSP publications, publishing approximately 18%. Given the limited existing bibliometric analyses on MSP, the authors expect that this study will contribute to literature and guide future research.

Keywords: *Marine spatial planning, Maritime spatial planning, Marine protected areas, Bibliometric analysis, VOSviewer*

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VOSVİEWER KULLANILARAK DENİZEL MEKÂNSAL PLANLAMA ARAŞTIRMALARININ BİBLİYOMETRİK ANALİZİ

ÖZ

Denizlerde yürütülen faaliyetlerin etkin bir şekilde düzenlenmesi ve doğal kaynakların akılcı bir şekilde yönetilerek denize alanı üzerindeki baskıların azaltılması için Denizel Mekânsal Planlamanın (DMP) uygulanması gerekir. Denizel mekânsal planlama konusundaki bilimsel araştırmaların nicel bir analizi, bu alandaki kritik bilgi açıklarını doldurmak, doğru politika ve stratejilerin belirlenmesine rehberlik etmek ve sürdürülebilir denizel alan yönetim pratiğini güçlendirmek açısından büyük bir öneme sahiptir. Bu çalışmanın amacı, denizel mekânsal planlama kavramıyla ilgili literatürün bibliyometrik bir analizinin yapılmasıdır. Veriler, Web of Science veri tabanından alınmış ve VOSviewer yazılımı kullanılarak analiz edilmiştir. Araştırmalar, belgelerin başlık, özet ve anahtar kelimelerinde "marine spatial planning" veya "maritime spatial planning" terimleri aranarak gerçekleştirilmiştir. DMP ile ilgili ilk çalışma, 2006 yılında yayımlanmış ve 2024 yılına kadar toplam 654 yayın yayımlanmıştır. Çalışma dönemi boyunca yıllık yayın sayısı artan bir eğilim göstermiştir. "Marine Policy" dergisi, DMP içerikli yayınların yaklaşık %18'ini yayınladığı ve DMP konulu makalelerde tartışmasız önde gelen dergi olarak ortaya çıkmaktadır. Literatürde DMP ile ilgili bibliyometrik temelli çalışmaların sınırlı olduğu dikkate alındığında, bu çalışmanın alanyazına katkı sağlaması ve gelecekteki araştırmalara yol göstermesi yazarların beklentileri arasındadır.

Anahtar Kelimeler: *Denizel mekânsal planlama, Deniz mekânsal planlama, Deniz koruma alanı, Bibliyometrik analiz, VOSviewer*

1. INTRODUCTION

Marine Spatial Planning (MSP) has emerged as a vital management strategy to reduce the pressure on marine ecosystems from increasing human activities and climate change worldwide (Ehler and Douvere, 2009). MSP aims to achieve ecological, economic and social objectives while organizing human activities spatially and temporally to ensure the sustainable use of marine areas. This comprehensive approach allows for effective and sustainable management of marine resources. In order to effectively implement MSP, it is necessary to evaluate existing scientific knowledge and guide future research. In this context, bibliometric analysis is an effective method to quantitatively assess current trends and developments in MSP literature. Bibliometric analysis identifies knowledge gaps and guides future research through statistical and mathematical analysis of scientific research (Racetin et al. 2022).

Seas and oceans are sometimes considered 'inexhaustible resources'. However, these resources are unfortunately not infinite. Research has shown that marine and ocean resources are also showing signs of depletion (Sevim, 2023). In some parts of the world, the total demand for marine space for human use has exceeded the available space by nearly three times (Balla and Wouters, 2017). While traditional uses such as fishing and shipping are intensifying, new uses such as aquaculture and offshore wind power plants have started to take up space in the increasingly industrialized marine area to meet this growing need. In addition to human activities, climate change impacts and natural disasters can have serious impacts on marine ecosystems. Therefore, it has become imperative to effectively regulate the activities carried out in the seas through MSP and to reduce the pressures on the marine area by rationally managing natural resources.

Traditional governance systems for marine and ocean affairs are built upon sectoral arrangements that are ineffective in coordinating and balancing actions across vastly different sectors with distinct sizes and requirements (Chalastani et al. 2020). Consequently, the concept of marine or maritime spatial planning has arisen as an important management strategy aimed at converting conflicts into resolutions, all the while overseeing diverse activities and users within the marine domain (Domínguez-Tejo et al. 2016). MSP is described as the public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to simultaneously achieve predefined ecological, economic, and social objectives, specified through a political process (Ehler and Douvere, 2009). Therefore, MSP serves as a hopeful instrument for optimizing the allocation of marine space for diverse activities, contributing to endeavors aimed at alleviating human impacts and rebuild marine ecosystems to fulfill the objectives outlined in the United Nations Sustainable Development Goals (United Nations, 2020; Ntona and Morgera, 2018).

Considering the importance of MSP in achieving local and global sustainability goals of marine areas, the scientific literature on this issue is expected to continue to grow in the coming years. In future, scientific research on MSP will assume a crucial role in actively guiding policy actions with science-based insights and solutions towards achieving marine sustainability (Claudet et al. 2020). A fundamental step needs to be taken to reduce conflicts between the sustainable use of marine areas and human activities. The vital task of promoting the sustainability of these areas in a planned manner will draw even more attention of the scientific community in the near future, especially to MSPs. Examining the scientific literature constitutes a crucial initial step in comprehending past research, current knowledge, and forecasting future trajectories of MSP science (Picone et al. 2021). In this context, bibliometric analysis has proven to be

a crucial and valuable approach for quantitatively evaluating patterns and trends in scientific literature (Chalastani et al. 2021; Polat et al. 2022). Bibliometric analysis is an efficient and popular method for studying and analyzing large volumes of scientific data (Picone et al. 2021; Akdeniz and Inam, 2024). This technique enables statistical and mathematical analysis of scientific research, revealing current trends and developments on a given issue. In this context, many bibliometric analysis studies have been carried out on the areas of interest of the "Marine Science" discipline (marine cadastre, marine spatial data infrastructure, marine spatial planning, marine ecosystem, marine geology, marine environment, etc.). Akdeniz and Inam (2024) conducted a bibliometric analysis study aiming to better understand the existing scientific knowledge on marine cadastre and to predict future trends. Chalastani et al. (2021) conducted a bibliometric analysis covering the MSP literature between 2003 and 2019. Racetin et al. (2022) conducted a bibliometric analysis of marine spatial data infrastructure literature indexed in the Web of Science database between 1996 and 2022. Zhou et al. (2022) analyzed the scientific literatures related to marine microplastics through a combination of social network analysis and bibliometrics. Cesarano et al. (2021) analyzed the scientific literature focusing on marine beach litter and tracks its evolution and trend by combining social network analysis and bibliometrics.

The aim of this study is to conduct a bibliometric analysis of the literature on the concept of MSP. The quantitative assessment of existing scientific research on MSP aims to fill critical knowledge gaps in this field, guide the development of appropriate policies and strategies for sustainable marine management, and identify future directions of scientific research. Given the limited bibliometric-based studies on MSP in the literature, this study is expected to make significant contributions to the literature and guide future research. Furthermore, the study provides a comprehensive bibliometric analysis of the literature on MSP in Türkiye, documenting the country's academic development in this field, identifying its shortcomings, and identifying future research and policy directions. In this way, it aims to increase Türkiye's scientific and applied contributions to maritime and coastal management issues and fills the existing scientific gap in the literature. Exclusively, we aimed to answer the following research questions:

1. Is there a scientific growth in marine spatial planning?
2. Which disciplines play a more active role in marine spatial planning research?
3. Who are the authors, publications and journals that have contributed the most to research on marine spatial planning?
4. Which countries are the most productive in marine spatial planning research? Is there cooperation between countries?

5. What are the research trends in marine spatial planning? With which keywords are they related?
6. Has the issue of marine spatial planning been examined in master's and doctoral theses published in Türkiye?

2. MARINE SPATIAL PLANNING

Administrators, planners, and engineers dealing with demands for marine spatial use and activities face many challenges in how to satisfy all potential stakeholders and their interests, and how to balance the use and protection of the marine area. In recent years, MSP has garnered attention as an integrated marine spatial management tool, offering a suitable framework for public authorities and stakeholders to 'coordinate their activities across sectors and administrative boundaries and optimize the use of marine resources (Schaefer and Barale, 2011). MSP can best be defined as the "public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process" (Ehler and Douvere, 2009). Nowadays, MSP is increasingly perceived as a mechanism capable of mitigating investment risks (Schütz and Slater, 2019). It involves the adoption of ecological and socioeconomic strategies to sustain coral reefs. Furthermore, MSP is acknowledged as an instrumental approach for promoting sustainable practices in fishing (Bastardie et al. 2017), marine aquaculture (Craig, 2019), and the overall development of marine areas. It plays a pivotal role in maintaining a necessary equilibrium between habitat preservation, species conservation, water protection regulations, and the implementation of Ocean Renewable Energy projects (van Hees, 2019; Taylor, 2023).

The first step in solving the problems of today and tomorrow may be laying the groundwork for more effective legislation, stronger education, and more scientific research on the issue. Merrie and Olsson (2014) point to an international conference on MSP organized by UNESCO's Intergovernmental Oceanographic Commission (IOC) in 2006 as the beginning of an increase in scientific research efforts on MSP. As interest in both the planning and implementation of MSP, as well as scientific research on the subject, has increased, numerous assessments of MSP challenges, successes and tools have been undertaken. Pinarbasi et al. (2017) delved into the decision support tools (DSTs) designed for the application of MSP, Gissi et al. (2019) scrutinized the integration of climate change into the MSP process, and Santos et al. (2019) evaluated the global implementation of MSP as a governance tool.

A quantitative analysis of scientific research on MSP is essential to fill critical knowledge gaps in the field, guide the development of

appropriate policies and strategies, and strengthen the practice of sustainable marine spatial management. Such analyses increase the body of scientific knowledge in the MSP discipline by providing a basis for future research and planning strategies. The aim of this study is to conduct a comprehensive and systematic bibliometric analysis of scientific research on MSP in Türkiye and globally until 2024.

3. METHODS

In this study, a bibliometric analysis of the literature on MSP was conducted. The bibliometric analysis was carried out according to the following steps: 1) identification of research questions; 2) performing the search on targeted databases based on specific search criteria; (3) screening the results of the literature search based on a predetermined set of criteria; and (4) answering the research questions from step 1 based on a predetermined set of criteria.

The research questions of the study are mentioned in the introduction section. The results section will be analyzed based on the research questions. In bibliometric analysis research, the literature on the subject is accessed from databases such as Web of Science, SCOPUS, PubMed, Dimensions, Google Scholar, etc. It is important that the chosen database represents the research issue. In this study, Web of Science (WoS) database was used. WoS database is widely used by researchers for literature review (Fang et al. 2018). Web of Science provides access to peer-reviewed journal publications and bibliographic information. It also provides access to a comprehensive collection of data from different disciplines. Web of Science is a comprehensive database because it has an evaluation process that produces certified information and contains journals with high impact levels (López-Bonilla and López-Bonilla, 2021). For these reasons, WoS database was preferred for the publications analyzed within the scope of the study.

Scientific publications were collected on 04.01.2024 from the WoS databases. The searches were performed using the string “marine spatial planning” OR "maritime spatial planning" on publication title, abstract and keywords. Boolean operators were employed to ensure the comprehensive collection of relevant references. The Boolean operator 'OR' was used to ensure the identification of either of the two keyword phrases (Chalastani et al. 2021). The search resulted in 1,943 publications published between 2006 and 2023. Exclusion and inclusion criteria were determined based on the search results. Among scientific publications, only publications published in article type and in English language were included in the study. By applying these criteria, the dataset was reduced to 1,654 publications (articles). All data, including author names, document type,

publication year, country and institution, subject categories, journals, title, author keywords and analyses, were collected from the WoS database. The workflow chart is shown in Figure 1.

In addition, within the scope of the research, graduate thesis studies published in Türkiye were examined through the National Thesis Center database. Thesis publications were collected on 07.01.2024 from the National Thesis Center databases. The searches were performed searching for the string “marine spatial planning” OR "maritime spatial planning" OR "denizel mekânsal planlama" OR "deniz mekânsal planlama" on thesis title and abstract.

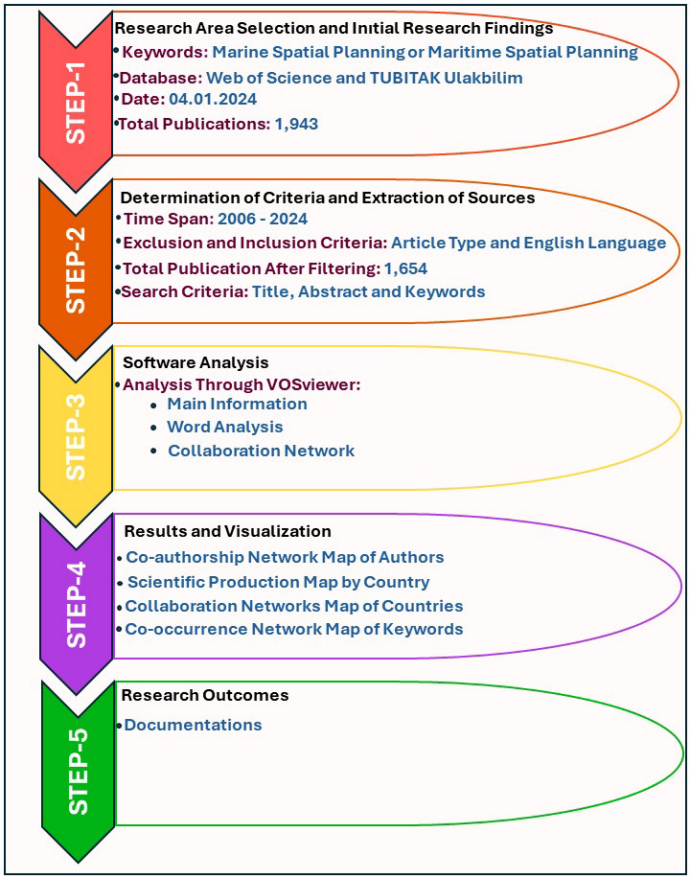


Figure 1: Workflow chart of bibliometric evaluation methodology of MSP

Bibliometric analysis provides a statistical and mathematical examination and evaluation of a specific issue. This analysis includes a set of quantitative and visualization procedures or statistics to generalize the

dynamics, current issues, and research trends in scientific publications (Li et al. 2018; Polat, 2019). The often-emphasized advantage of bibliometric analysis is the possibility to process large volumes of scientific data and transform it into valuable information. This allows some rigor to be brought to the composition of the literature on a specific scientific issue (Sanguankaew and Vathanophas Ractham, 2019). According to Zupic and Čater (2015), bibliometric analyses enable the identification of main trends in a research area, the description of its development and structure, and the synthesis of elements that contribute to defining the intellectual structure of the knowledge base. In other words, it enables statistical analysis of data such as authors, subjects, cited publications, etc., and in the light of the results obtained, it enables the general structure of a specific scientific issue to be revealed.

In this study, bibliometric analysis was used to answer the research questions. In this context, the trend in the number of publications on the issue, the most publications disciplines/areas , the most cited authors, the relationships between authors, the journals that published the most studies on the issue, the most effective publications, the countries that did the most studies on the issue, the publication cooperation between countries, the most used keywords, and the number of master's and doctoral theses on the issue in Türkiye, distribution by disciplines, the most used keywords in theses, etc. were examined.

The results from the database were analyzed using VOSviewer (version 1.6.20), a software tool designed to create network maps based on bibliometric data. VOSviewer is a freely available software for analyzing and visualizing bibliometric data from the WoS database (van Eck and Waltman, 2023). The size of the circles and labels in the network maps represent the number of occurrences, in short, the number of times the data is repeated. Colors represent clusters. The proximity between two circles reveals similarity and the strength of the relationship (Khalil and Crawford, 2015). VOSviewer enables word co-occurrence analysis and co-authorship analysis, as well as the exploration of citation networks, co-authorship patterns and other bibliometric information through network maps (Ongun, 2023). In summary, the advantage of this software is that it enables detailed analysis of datasets by providing mapping, visualization, and multidimensional analysis.

4. RESULTS

The results of this study are presented according to the foci points of the research questions.

4.1. Is There a Scientific Growth in MSP?

This section aims to answer the first research question by examining the volume and growth trajectory of the literature on MSP. The number of publications by year is shown in Figure 2. The first study on MSP was published in 2006. Until 2024, 1,654 publications on MSP were published. The number of publications per year showed an increasing trend throughout the research period.

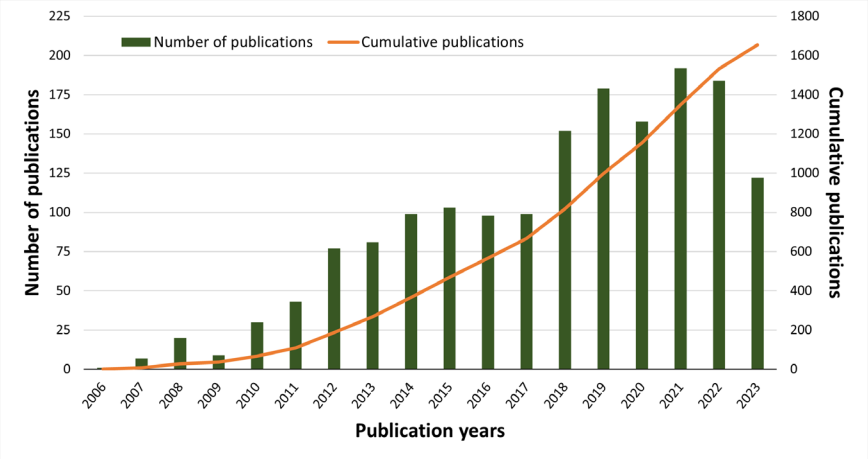


Figure 2: The number of publications and cumulative publications on a yer-on-year basis

In 2021 and 2022, it almost reached a peak (n=192 and n=184, respectively). The total number of publications in these two years accounts for about 23% of the all-time number of publications. The cumulative number of publications rose from 1 in 2006, coinciding with the organization of the first international workshop on MSP, to 28 in 2008. The years 2010 and 2014 are considered pivotal in the development of MSP, highlighted by its establishment as a policy framework (US Executive Order 13547 and Directive 2014/89/EU, respectively) (Chalastani et al. 2021). Despite the decrease in the number of publications in 2023, all these results show that literature in MSP continues to grow and is a current research area.

4.2. Which Disciplines Play a More Active Role in MSP Research?

In order to answer the second research question, the distribution of MSP publications according to the disciplines/categories identified by the Web of Science database was analyzed. The WoS category distribution of MSP publications (top 10 categories) are given in Table 1. It was determined that most of the MSP studies addressed by different disciplines (n=78) were conducted in the Environmental discipline (945 publications), followed by Marine Freshwater Biology (350 publications), Oceanography (334 publications) and International Relations (296 publications). It is stated that the engineering discipline gives relatively less importance to MSP, especially Engineering Ocean (34) and Engineering Marine (22) categories have a high number of publications. In the Regional Urban Planning category, 56 publications were published.

Table 1: Web of Science category distribution (top 10 categories)

Categories	Number	Rate (%)
Environmental Sciences	494	29.87
Environmental Studies	451	27.27
Marine Freshwater Biology	350	21.16
Oceanography	334	20.19
International Relations	296	17.90
Water Resources	218	13.18
Ecology	205	12.39
Biodiversity Conservation	153	9.25
Fisheries	88	5.32
Multidisciplinary Sciences	62	3.75

4.3. Who Are the Authors, Publications and Journals That Have Contributed the Most to Research on MSP?

In this section, "most cited articles", "most published journals", "most cited authors" and "co-authorship" were analyzed to answer the third

research question. This research question aims to identify the main researchers or authors and journals related to MSP.

A citation analysis was performed for articles with a minimum of 100 citations. The 5 most cited articles in the MSP are identified. The most cited article was published in Science by Halpern et al. in 2008 (n=4340). The aim of the article is "analyzing the impact of anthropogenic factors on 20 different marine ecosystems and developing effective management policies and plans against adverse impacts. The second most cited article, published in 2008 with 706 citations, emphasizes the significance of MSP in advancing ecosystem-based sea use management. Authored by Douvere (2008), the article delves into the essential role of MSP, its definition, and core objectives in achieving effective ecosystem-based sea use management. This was followed by two notable articles, one addressing the incorporation of cultural and social dimensions in ecosystem services, authored by Chan et al. (2012) with 676 citations, and another focusing on addressing the shortcomings of marine protected areas through large-scale MSP, authored by Agardy et al. (2011) with 456 citations. The 10 journals with the highest number of publications on MSP were analyzed (Table 2). There were 349 different journals that published at least 1 publication related to the MSP. As a result of the analysis, the journal 'Marine Policy' establishes itself as the premier source for MSP publications, publishing approximately 18% (n=291). "Marine Policy" is dedicated to the study of ocean policy and includes analyses within the primary social science disciplines pertinent to the development of marine policy (Chalastani et al. 2021). The 291 articles published in the journal have received a total of 11,351 citations. This journal was followed by Ocean & Coastal Management (156 articles, 9.4%), Frontiers in Marine Science (87 articles, 5.3%), ICES Journal of Marine Science (38 articles, 2.3%) and Sustainability (33 articles and 2.0%). The total number of publications in the top 10 journals (n=667) constitutes 40% of the total number of MSP publications (n=1654). The distribution of publications across these journals shows the diversity and magnitude of interest in MSP. It also reflects the many different aspects that MSP can involve.

Table 2: The ten most published journals in the MSP literature between 2006 and 2023

Rank	Journal	Number and Percentage of Publications	Total Citations
1	Marine Policy	291 (17.6%)	11351
2	Ocean & Coastal Management	156 (9.4%)	3295

3	Frontiers in Marine Science	87 (5.3%)	985
4	ICES Journal of Marine Science	38 (2.3%)	859
5	Sustainability	33 (2.0%)	252
6	Journal of Environmental Management	28 (1.7%)	657
7	Plos One	27 (1.6%)	1321
8	Marine Ecology Progress Series	27 (1.6%)	502
9	Biological Conservation	26 (1.6%)	678
10	Marine Pollution Bulletin	26 (1.6%)	555

The third research question also analyzed the most prolific authors in MSP. For this analysis, the most highly cited authors were identified. Their current affiliation, country, number of articles, citations and citations per article were also identified. Table 3 lists the 10 most highly cited authors in MSP.

Table 3: The ten most highly cited authors writing on MSP

Author	Current Affiliation	Country	Article	Citations	CPD
Benjamin S. Halpern	U. of California	USA	18	7314	406.33
Fiorenza Micheli	U. of Stanford	USA	6	4787	798.83
Rod Fujita	Environmental Def. Fund	USA	3	4553	1517.67
Elizabeth R. Selig	U. of Stanford	USA	3	4491	1497.00
Mary Ruckelshaus	U. of Stanford	USA	8	1400	175.00
Fanny Douvere	UNESCO	-	4	1254	313.50
Larry B. Crowder	U. of Stanford	USA	6	1208	201.30
Daniel C. Dunn	U. of Queensland	Australia	9	1035	115.00
Anne D. Guerry	U. of Stanford	USA	5	986	197.20
Kai M.A. Chan	U. of British Columbia	Canada	3	931	310.30

A total of 6,983 authors contributed to 1,654 articles in the WoS database between 2006 and 2023. The most prolific author is the American author "Benjamin S. Halpern" with a total of 18 articles and a total of 7,314

citations. He is followed by "Fiorenza Micheli" with 6 articles and 4,787 citations and "Rod Fujita" with 3 articles and 4,553 citations. The author with the highest number of citations per article is "Rod Fujita" (n=1517.67). It is also noteworthy that the most highly cited authors differ substantially from the most prolific authors. When the top three most cited authors and their publications were analyzed, it was determined that they conducted research on the sustainable management of marine ecosystems.

The thickness of the connection between two nodes indicates the extent of collaboration between those two authors. In summary, the thicker the connection, the stronger the collaboration between authors (Figure 3).

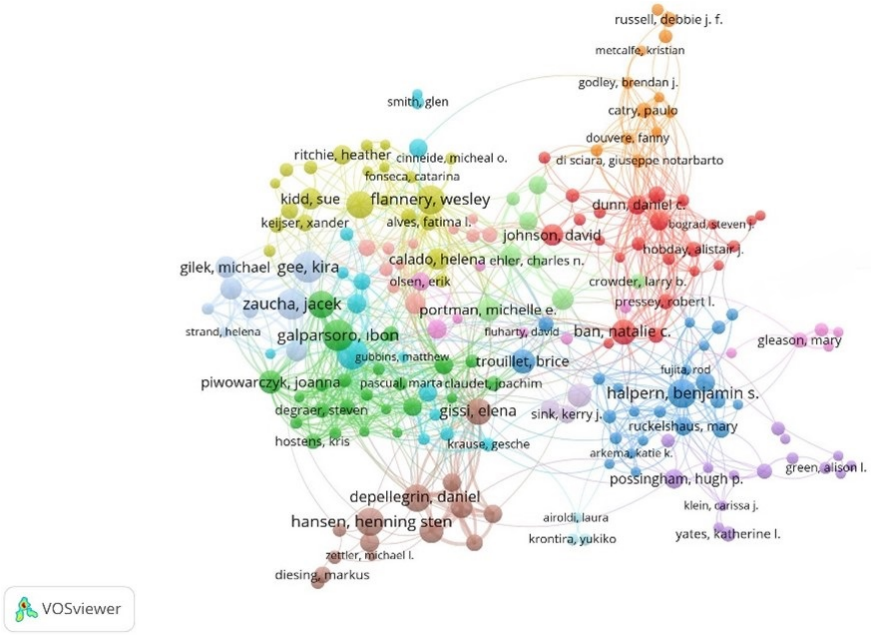
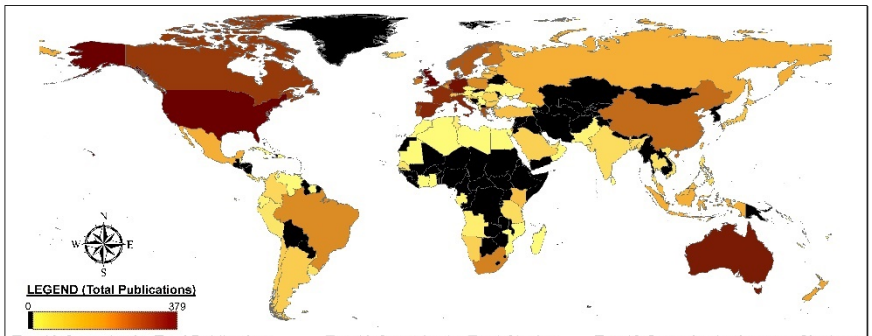


Figure 3: Co-authorship network map of authors on MSP-based research (The map shows the 200 most well-connected authors)

4.4. Which Countries Are the Most Productive in MSP Research? Is there Collaboration Between Countries?

Figure 4 was produced using ArcGIS Pro software. It shows the scientific production of each country in the world and provides an answer to the fourth research question. Figure 4 shows the spatial distribution of MSP article publications.

The 118 different countries contributed to 1,654 publications on MSP. The top 10 countries with the highest number of publications (article), citations and average number of citations are listed in Figure 4. When Figure 4 is examined, it is seen that USA institutions, organizations or companies are represented by almost 23% (379 publications) of the leading MSP authors. Within countries, the ranking of contributions to MSP, England ranks second with 18% (297 publications), Germany ranks third with 10% (172 publications), Australia and Italy rank fourth and fifth with 9% (154 and 149 publications). Türkiye contributed to the literature with 14 publications (0.8%). Türkiye ranks 38th among the most productive countries. When the regional distribution of scientific productivity is examined, it is seen that the regions with the highest number of publications are European Union countries, North America, and Australia. Especially in Africa and the Far East, there are many countries that do not conduct research on MSP For obtaining accurate answers, a comprehensive analysis of the issue should certainly be conducted, encompassing the legislation of individual states, strategies, and goals of both the state and the international community (Racetin et al. 2022). In summary, the distribution and number of contributing countries show that MSP is internationally significant and gains recognition.



Top 10 Countries by Total Publications

	Country	Articles	TC	AC
1	USA	379	19426	51.26
2	England	297	12861	43.30
3	Germany	172	3861	22.45
4	Australia	159	5713	35.93
5	Italy	154	4215	27.37
6	Spain	149	2585	17.35
7	France	141	5238	37.15
8	Scotland	138	3088	22.38
9	Canada	127	9526	75.01
10	Portugal	102	2017	19.77

Top 10 Countries by Total Citation

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1	USA	379	19426	51.26
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3	Canada	127	9526	75.01
4	Australia	159	5713	35.93
5	France	141	5238	37.15
6	Italy	154	4215	27.37
7	Germany	172	3861	22.45
8	Scotland	138	3088	22.38
9	Spain	149	2585	17.35
10	Sweden	75	2108	28.11

Top 10 Countries by Average Citations

	Country	Articles	TC	AC
1	Canada	3	337	112.33
2	Canada	127	9526	75.01
3	Mexico	18	1320	73.33
4	India	7	435	62.14
5	USA	379	19426	51.26
6	England	297	12861	43.30
7	Malaysia	15	632	42.13
8	France	141	5238	37.15
9	Australia	159	5713	35.93
10	Belgium	45	1391	30.91

Figure 4: Scientific production by country related to the term "MSP"

Figure 5 shows the map of collaboration between countries. This analysis restricted the number of countries with at least 5 articles out of

118 countries. There were 61 countries that met this condition. The nodes' size reflects the number of articles published by each country, with larger nodes indicating a higher publication count. The links between countries represent the number of co-authorship articles between the linked countries. In essence, a thicker link denotes a greater number of articles on which the two countries have collaborated.

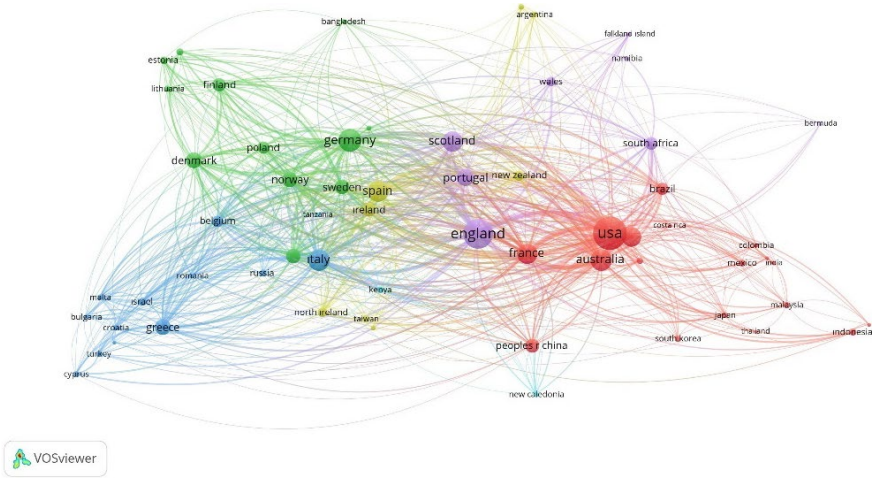

Figure 5: Collaboration networks of countries in MSP research during 2006-2023

When Figure 5 was analyzed, two countries with intense collaboration both among themselves and across the world come to the fore: USA and England.

4.5. What Are the Research Trends in MSP? Which Keywords Are They Related?

In this section, "most used keywords" was analyzed to answer the fifth research question. For the bibliometric analysis of the most used keywords, the analysis type selected was 'Co-occurrence,' with 'Authors keywords' identified as the unit. (Abuhassna et al. 2022). As a result of the analysis, 4275 keywords were identified.

Restriction criteria were applied to obtain more meaningful results. In this context, a minimum of ten repetitions of a keyword was enforced. In addition, similar keywords were combined by creating a thesaurus file. For instance, the keywords "marine spatial planning", "MSP", and "marine spatial planning (msp)" were all merged under the term "marine spatial planning". The number of keywords was reduced from 4275 to 83. Co-occurrence keywords network map is shown in Figure 6.

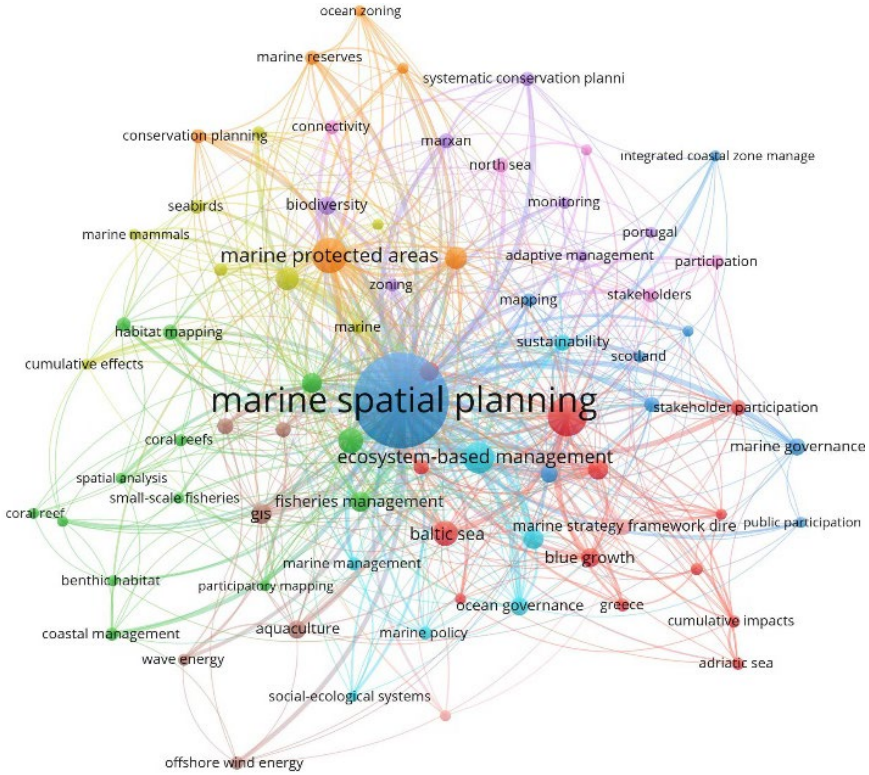

Figure 6: Co-occurrence network map of keywords in the global Scientific literature on MSP

The most frequently used keywords in the database are "marine spatial planning (717)", "maritime spatial planning (121)", "marine protected areas (100)", "ecosystem-based management (79)" and "ecosystem services (49)". In the network map, each keyword is presented by a circle and the size of the circle is proportional to the number of publications in which the keyword is found. Each color represents a group of keywords merged into clusters. The thickness of the connections indicates the frequency of occurrence of two keywords together. The resulting network illustrates the close relationship between "MSP" and protected areas, ecosystem-based management, the marine environment, human activities, and blue growth (Figure 6).

4.6. Has the Issue of MSP Been Examined in Master's and Doctoral Theses Published in Türkiye?

Postgraduate thesis studies on MSP research area in the National Thesis Center database are listed in Table 4. It was determined that six postgraduate theses on MSP were published, comprising 50% master's and 50% doctoral theses. The first thesis was published in 2018. Among these theses, four were published in Turkish, while two were published in English. When the distribution of the theses according to the departments was examined, it was determined that each of them was in a different department or sub-discipline (Communication Systems, Marine Environment, Civil Engineering, Marine Resources Development and Protection, Marine Transportation and Management Engineering, Urban and Regional Planning). This result shows once again that MSP should be handled in a multidimensional, comprehensive, and holistic manner. When the most used keywords in the theses were analyzed, it is seen that the keywords "marine spatial planning", "ecosystem-based management" and "integrated marine management" were used.

Table 4: General information on master's and doctoral theses published in Türkiye

Thesis	Year	Author	Supervisor	Thesis Type	Department
Commercial fisheries as a component of marinespatial planning in the north sea: Using gis toexplore future developments	2018	Tuğba Kaya	Alastair Lyndon	Master's	Marine Resource Development and Protection
Kıyı alanları planlaması bağlamında bütünleşik kıyı alanları yönetimi ve planlaması: İzmit körfezi (Kocaeli-Yalova) bütünleşik kıyı alanları planı örneği	2019	Esra Şentürk	Adem Erdem Erbaş	Master's	Urban and Regional Planning
Türkiye deniz alanlarının ekosistem tabanlı deniz alanları planlaması	2021	Sencer Baltaoğlu	Cem Gazioğlu	PhD	Marine Environment

açısından değerlendirilmesi					
CBS tabanlı denizel mekânsal planlama sistemi ile denizüstü rüzgâr santrallerinin değerlendirilmesi: Kuzey Ege örneği	2021	Arife Tuğsan İşiaçık Çolak	Çiğdem Köksal	PhD	Communication System
Deniz yapılarının çok kriterli karar verme yöntemi (ÇKKV) ile planlanması ve tasarım parametrelerinin uyarlamalı ağ tabanlı bulanık çıkarım sistemi ile tahmini	2023	Büşra Biçer Aymergen	Can Elmar Balas	Master's	Civil Engineering
Comprehensive analysis of integrated maritime spatial planning requirements in Black Sea	2023	Alaettin Sevim	Mustafa Taner Albayrak	PhD	Maritime Transportation and Management Engineering

5. DISCUSSIONS

The necessity of extracting a quantitative summary through bibliometric analyses has increased for research issues that are significant and prioritized, possessing an extensive literature. Despite the growing popularity of bibliometric studies, the number of scientific studies that include bibliometric analysis of MSP in the literature is limited. The only study on MSP literature is by Chalastani et al. (2021), who conducted a bibliometric analysis of MSP publications published in the WoS and SCOPUS databases from 2003 to 2019. The results of the study have important similarities with Chalastani et al. (2021). In their study, Chalastani et al. (2021) found that the MSP literature showed a rapid growth until 2019, the journal that published the most MSP publications was "Marine Policy", and the authors who contributed the most to MSP worked in institutions, organizations and companies in the USA. In addition, in this study, they determined that 61 countries contributed to MSP until 2019. In this study, it was determined that the number of

countries contributing to the MSP increased to 118 by 2024. This result clearly shows that the MSP continues to grow rapidly and is gaining importance day by day. However, there are also some differences between the two studies. The studies focus on different targets, use different databases and examine different time periods. These differences reflect the broad scope and dynamic nature of the MSP literature, suggesting that both studies make valuable contributions to the field.

The results of the bibliometric analysis provide valuable information to researchers and policy makers in this field by identifying which topics in the MSP literature need further research. This study unveiled that MSP is a rapidly expanding research area. Nevertheless, the results may not encapsulate the entirety of MSP endeavors, as the outcomes of MSP processes are not consistently reported in scientific publications, given their association with politically driven processes that may extend over a decade (Gissi et al. 2019; Chalastani et al. 2021). MSP started with the Great Barrier Reef in Australia, and the EU MSP Directive (2014/89) was a major milestone in its development. This directive states that EU countries must prepare marine spatial plans by March 31, 2021. The analysis results indicate that the majority of MSP publications are published by countries in the European continent. However, United States researchers, who pioneered ocean science, continue to lead the way in terms of both the number and quality of publications.

Türkiye is surrounded by seas on three sides and has a coastline length of 8333 km (Akdeniz and Inam, 2021). However, it was determined that Türkiye was not enough interest in MSP. It was determined that 14 articles, 3 master's and 3 PhD thesis were conducted related to MSP. Türkiye, which is a marine country due to its geographical location, should be more devoted and aware of "MSP". Nevertheless, considering the growing urgency and significance of sustainability issues in developing societies with marine areas, such as Türkiye, we anticipate that future reviews will highlight a larger proportion of documents on this issue authored in these countries (Sanguankaew and Ractham, 2019).

Scientific journals, particularly 'Marine Policy,' hold a prominent position in publishing content related to MSP with 'Ocean and Coastal Management' ranking second. This highlights MSP's primary focus on strategically planning the utilization of marine areas to promote sustainable ocean management and governance (Santos et al. 2019). In the keywords co-occurrence network (Figure 6), the strong connection of the keyword "marine spatial planning" with terms such as "ecosystem-based management", "sustainability", "protected areas", and "stakeholder participation" signifies that MSP is a participatory process aimed at the sustainable utilization of marine spaces.

Researchers in engineering and planning disciplines, possessing the authority and potential to execute technical applications, are inadequately represented in the published literature. Particularly, considering the proficiency of researchers in engineering disciplines in modeling, future scenarios, optimum use of marine areas and geographic information systems, it is thought that their contributions to the MSP will be enormous.

6. CONCLUSION

The MSP is a type of planning that has become increasingly important in recent years. It has an important role in the sustainable use of marine areas within the balance of protection and use. In this study, a bibliometric analysis of the "MSP" literature was conducted. The results revealed that MSP is a rapidly growing field. To foster this growth, it's crucial to establish collaborative international programs and forge closer connections with policymakers to ensure the adoption of MSP outcomes.

In response to the first research question, it was found that there has been a rapid increase in scientific publications on MSP, especially in the last 10 years. Environmental and marine scientists were observed to play a more active role in MSP. "Marine Policy" was found to be the most prolific journal. The United States of America was found to be the country that contributed the most to the literature. Türkiye was ranked 38th among the most productive countries. In response to the fifth research question, it was determined that MSP is closely related to "protected areas, ecosystem-based management and blue economy". In master's and doctoral theses published in Türkiye, MSP has been studied very limitedly (6). Therefore, in order to carry out effective studies and public opinion formation in the scope of MSP, it should be ensured that these topics are included in the curricula of universities, graduate theses with academic content and scientific projects should be developed.

Considering that bibliometric-based studies on MSP are limited in the literature, it is among the expectations of the authors that this study will contribute to the literature and guide future research. In addition, it is possible to say that future MSP studies conducted by researchers from various disciplines (especially engineering and planning) will provide a more comprehensive and qualified contribution to the related field.

Of course, this study has certain limitations. First, only WoS was used as a database. SCOPUS, ScienceDirect, etc. databases and TUBITAK Ulakbilim database in Türkiye were excluded. Therefore, this study does not cover all academic journals, which is the most critical limitation. Future research should include other important databases such as SCOPUS, ScienceDirect as well as the TUBITAK Ulakbilim database in Türkiye. Secondly, only journal articles were considered, excluding conference

papers, books, book chapters, and other scientific works. Future research should be expanded to include other scholarly works such as conference papers, books, book chapters. Conference papers, in particular, are an important source of rapidly changing and innovative research findings, and analyzing such studies can provide a better understanding of the dynamics of the field. Finally, bibliometric research, by their nature, does not extensively explore the specific findings of scientific studies. Future research should analyze specific findings on MSP in depth, integrating bibliometrics with supporting qualitative research.

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YAZAR KATKISI

KATKI ORANI	AÇIKLAMA	KATKIDA BULUNANLAR
Fikir	Araştırma fikrini geliştirmek ve hipotez oluşturmak	Yazar 1 & Yazar 2
Literatür Taraması	Araştırmanın literatür taramasını gerçekleştirmek	Yazar 1
Araştırma Tasarımı	Araştırmanın yöntemini ve ölçekleri belirlemek	Yazar 1
Veri toplama ve editleme	Veriyi toplama, editleme ve analiz etmek	Yazar 1
Tartışma ve sonuçlar	Bulguların tartışılması ve sonuçların yazımı	Yazar 1 & Yazar 2

Çıkar Çatışması

Çalışmada yazarlar arasında çıkar çatışması yoktur.

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