

Marine Ranching Studies: Insights from a Bibliometric Perspective

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Abstract: As a sustainable development model to coordinate ecological restoration and fishery proliferation, marine pasture has become the frontier field of global marine science in recent years under the background of the decline of offshore resources. It constructs a complex ecosystem through key technologies such as habitat building and biological domestication, and achieves the dual goals of efficient development of fishery resources and enhancement of marine carbon sink capacity. In this paper, 480 documents in WoS database are visually analyzed by bibliometrics method, and the research status and trend are revealed. Future research needs to strengthen interdisciplinary integration, focus on breaking through key technical bottlenecks such as digital twinning of pasture ecosystem, and help the implementation of the "blue granary" strategy.

Keywords: Marine pasture; Artificial reef; VOSviewer; Bibliometric analysis; Blue granary.

1. Introduction

Marine pasture is a new format of marine economic development, an important means to obtain resources from the ocean, optimize industrial layout and repair the ecological environment of the sea area, and also an important measure to implement the strategy of strengthening the country by the sea. The coastal marine habitats in many countries have been destroyed and polluted, which has seriously affected marine fisheries. In order to solve the food problem, many coastal countries have taken the development of marine pastures as an important strategy for fishery development.

Bibliometrics method is recognized by most countries as a useful decision support tool for determining research priorities and tracking the evolution of science and technology. In view of the universality of bibliometrics, these methods in bibliometrics have been rapidly extended to different scientific fields. This method can provide a macro overview of a large number of academic documents, and can also be used to effectively identify influential research, authors, journals, organizations and countries in a period of time. Based on this, this paper uses the bibliometric software such as VOSviewer and BiblioShiny to analyze the articles related to "Marine Ranch" from the visual point of view, and presents them in the form of visual maps and data charts.

2. Methods

2.1. Data Source and Retrieval

In this study, we obtained literature data from SCIE and SSCI in WoS. We will design the research time span from May 20, 2005 to May 20, 2025, which ensures that the literature we retrieved covers a long period of time and provides a deeper foundation for a comprehensive understanding of the research topic. In the process of literature retrieval, we first defined the types of literature,

mainly focusing on article and review. We use ((ts = (marine ranging)) or ts = (ocean ranging)) or ts = (ocean ranging) as a clear retrieval strategy.

2.2. Bibliometric Analysis

We choose Citespace (version 6.1. R6) for citation visualization and analysis, which is a software dedicated to scientometrics and data visualization. In addition, we also use Vos Viewer (version 1.6.20), which is a software specially used to build and view bibliometrics.

By using CiteSpace and VOSviewer, we have successfully built a visual coupling network between different journals, countries, co-authors and different related keywords, and made corresponding contact lines, which can help us clearly identify citation burst data and draw a visual map.

3. Results

3.1. Keyword Analysis

The article keywords are the reliable basis for reflecting the research theme and revealing the hot spots in the field. In this study, we used VOSviewer software to analyze the keywords of "Marine Ranch" in the WoS database on a large scale. According to the statistics of relevant data, we used VOSviewer software to screen 51 keywords with frequency ≥ 5 times.

By using the keywords in this article and constructing the time distribution map of keywords, we found that the high-frequency keywords we screened mainly focused on the following four aspects: "marine ranching", "sea ranching", "stock enhancement" and "artificial reef". These four keywords are divided into four main research groups by cluster analysis, and the close relationship between each group can ensure that it not only reflects the characteristics of cross-integration of different disciplines, but also fully reflects the systematic development trend of ecosystem

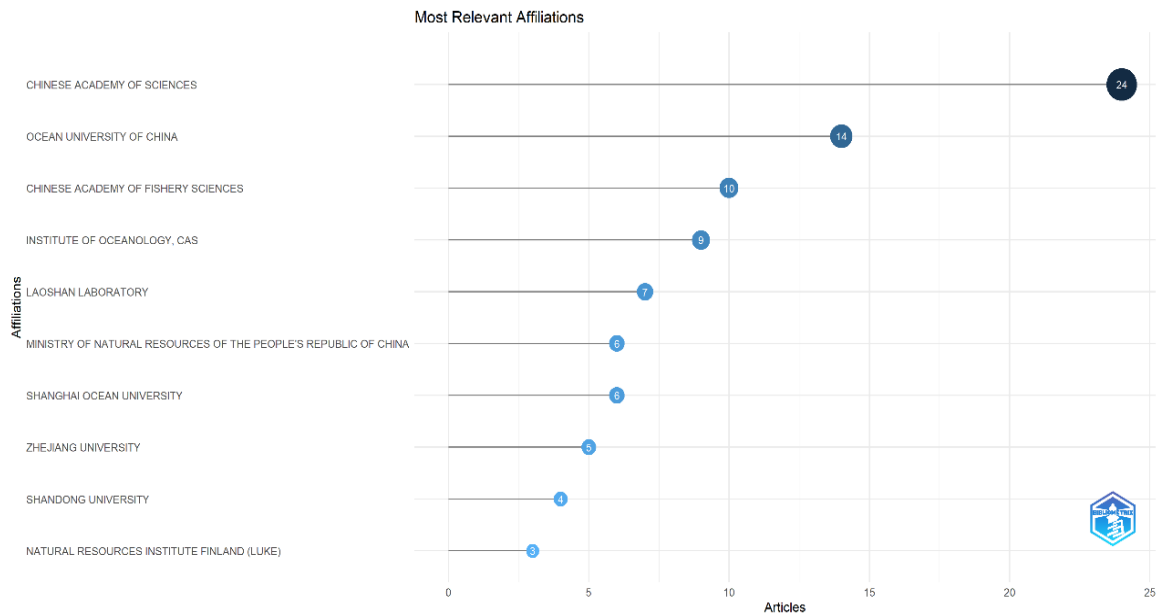


Figure 5. The 10 most relevant institutions participating in the publication.

3.4. Author's Analysis

By using VOSviewer software to construct the author's cooperative network map, it is found that 53 authors have formed a relatively close cooperative network. In the visual atlas, the cooperative relationship between authors is clearly presented by connecting lines. The number and thickness of connecting lines directly reflect the frequency and closeness of cooperation, while the number of papers produced by each author is expressed by the size of a circle. The larger the circle, the more relevant papers published on behalf of the author.

Based on the visual atlas drawn by the research data, the top ten core authors in the field of marine pasture activity are presented intuitively. In this group, Professor Yuan-Wei Du, with his rich academic achievements and extensive cooperation network, has made outstanding contributions in promoting the development of the field. Through the comprehensive analysis of Taylor Matthew D.'s cooperation connection density, cross-institutional cooperation scope and the number of participating projects, it is found that Taylor

Matthew D. actively establishes cooperative relations with domestic and foreign scientific research teams and plays an important role in academic exchange and achievement creation.

Table 1. Top ten authors with the most published papers in WOS

Number	Number of Publications	Author
one	17	Yuan-Wei Du
2	17	Taylor Matthew D.
three	seven	Cotter Diane
four	five	Assaf Barki
five	four	Bjorn Bjornsson
six	four	Blankenship H. Lee
seven	four	Loneragan Neil R.
eight	four	Jonasson Jimmy
nine	four	Hafsteinnsson Hannes
10	four	Xiao-Le Wan

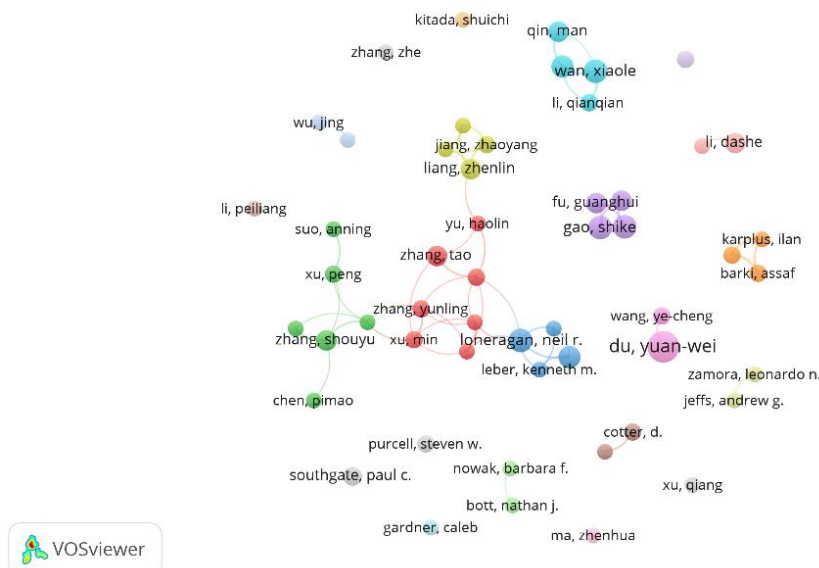


Figure 6. Co-author network of participating authors.

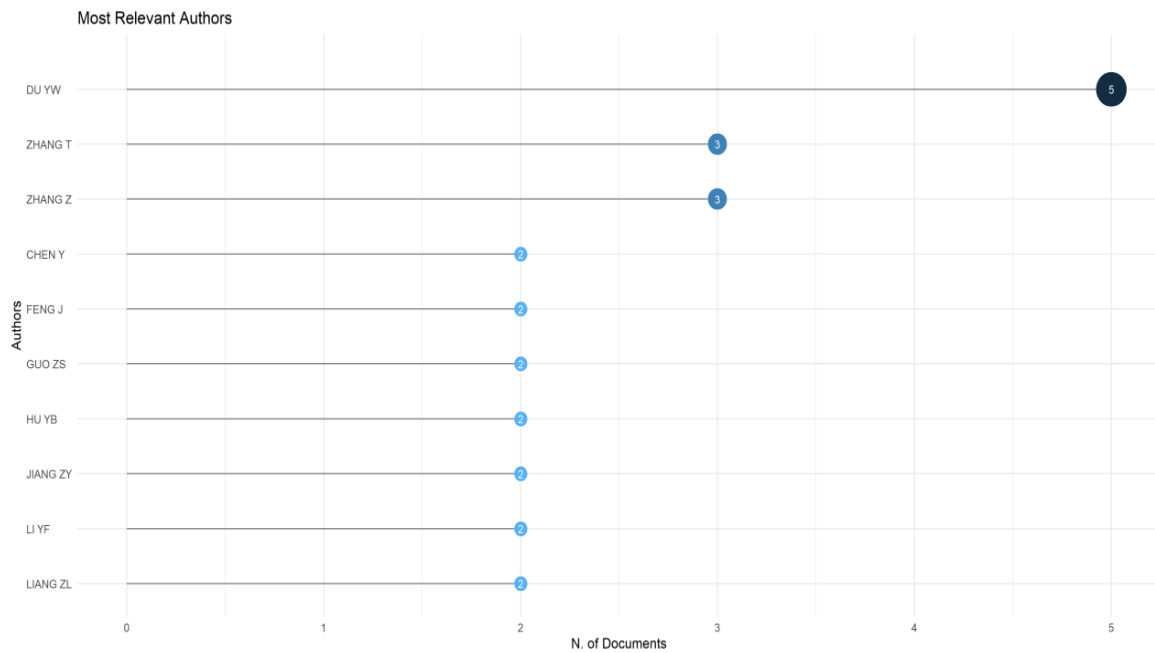


Figure 7. The 10 most relevant authors who contributed to the article.

3.5. Research Hotspot Analysis

In the literature citation of key words, this paper comprehensively analyzes and reveals the key roles of four professional terms, such as "marine aquaculture", "survival", "wild" and "stock enhancement", in the study of marine pasture. These 20 keywords fully reflect the core position of marine pasture in the protection of wild resources and the technology of proliferation and release.

The core focus of this study is to use artificial intervention (including technical measures such as seedling breeding, proliferation and release) to effectively improve the survival rate of wild fish populations and enhance their self-repair and

regeneration capabilities. However, with the intensification of global climate change, the continuous rise of seawater temperature and the problem of ocean acidification are not optimistic, which poses a serious threat to the survival and reproduction of proliferating and releasing species. Under this challenge, the relevant research has to adjust its direction in time, shift its focus to the breeding of high-temperature resistant varieties, and strengthen the comprehensive evaluation of species' ecological adaptability. In addition, three keywords such as "fishery", "artificial reef" and "economic assessment" show that marine pasture plays an important role in resource management and economic benefit balance.

Changes in the number of keywords over the years

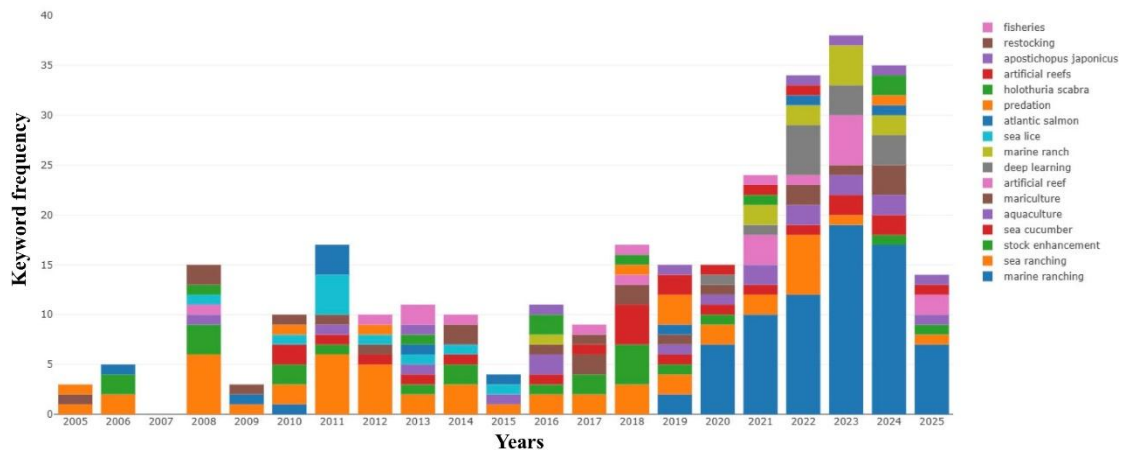


Figure 8. Changes in the number of keywords over the years

4. Discussion

Through systematic combing and in-depth analysis of the related literature in the Web of Science (WoS) database, this study has completed a comprehensive literature measurement work. The results show that in the field of marine pasture research, the output scale of China's early academic achievements is relatively limited, and the initial stage of research lags behind the overall international development process, but the development speed is obviously improved.

5. Conclusion

In recent years, the number of academic and popular science publications on marine pastures has been increasing all over the world. This phenomenon not only directly reflects the remarkable increase of attention from all walks of life to marine pastures, but also reflects the growing interest of people in different countries in marine pasture research. From the optimization of habitat construction technology of marine pasture to the innovation of biological proliferation

technology of marine pasture, and then to the research on the technology of far-reaching marine aquaculture platform, these studies reflect the innovation in technology and theory, and also lay a solid foundation for subsequent development. Especially in marine engineering, equipment industry development, environmental and ecological protection and many other aspects, the application of marine pasture has greatly promoted the scientific and technological progress and technological innovation of unmanned systems in the field of marine engineering, and provided new ideas and solutions for solving practical problems.

6. Future Development Trends and Challenges

Looking forward to the future, the development prospect of marine pasture is broad. While welcoming many development opportunities, it will also face a series of complex challenges, and the coexistence of opportunities and challenges is an important driving force to promote the continuous innovation of marine pasture. With the improvement of environmental awareness, marine pastures will pay more attention to environmental protection and sustainable development, and adopt different but effective measures such as ecological farming, energy saving and emission reduction, with the main purpose of protecting the marine ecological environment and achieving a win-win situation of economic benefits and ecological benefits. However, in the extreme environment of deep sea, the equipment reliability, the lack of cross-industry chain coordination mechanism and the uncertainty of ecological carrying threshold are still the key issues that need to be paid attention to in the future research and development of China and many countries.

References

- [1] Yang, J.L.; Wu, X.Y.; Shi, G.F.; Chen, Y. Overview of marine ranching technology. *Chin. Fish. Econ.* 2004, 5, 48–50. (In Chinese)
- [2] Bell, J.D.; Leber, K.M.; Blankenship, H.L.; Loneragan, N.R.; Masuda, R. A new era for restocking, stock enhancement and sea ranching of coastal fisheries resources. *Rev. Fish. Sci.* 2008, 16, 1–9. [CrossRef]
- [3] Yang, H.S.; Zhang, S.Y.; Zhang, X.M.; Chen, P.M.; Tian, T.; Zhang, T. Strategic thinking on the construction of modern marine ranching in China. *J. Fish. China* 2019, 43, 1255–1362. (In Chinese)
- [4] Li, Z.Y.; Lin, Q.; Li, J.; Shan, X.J. Present situation and future development of marine ranching construction in China. *J. Fish. China* 2019, 43, 1870–1880. (In Chinese)
- [5] Zeng, C.K. Some issues concerning the agricultural and pastoral production of aquatic products in China's exclusive economic sea area. *Resour. Sci.* 1979, 1, 58–64. (In Chinese)
- [6] Zhang, S.S. On the theory and technology of the marine propagated fisheries. *J. Fish. China* 1983, 7, 279–285. (In Chinese)
- [7] Lu, Z.K. Status, problems and countermeasure for exploitation and research of marine ranching in China. *Fish. Inf. Strategy* 1995, 10, 6–9. (In Chinese)
- [8] Zeng, C.K.; Mao, H.L. The development, current situation, and prospects of oceanography. *Chin. Sci. Bull.* 1965, 10, 876–883. (In Chinese)
- [9] Mejia, C.; Wu, M.; Zhang, Y.; Kajikawa, Y. Exploring topics in bibliometric research through citation networks and semantic analysis. *Front. Res. Metr. Anal.* 2021, 6, 742311. [CrossRef]
- [10] Van Eck, N.J.; Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 2010, 84, 523–538. [CrossRef]
- [11] Koo, M. A bibliometric analysis of two decades of aromatherapy research. *Bmc Res. Notes* 2017, 10, 46. [CrossRef]
- [12] Zion B, Karplus I, Barki A. Ranching acoustically conditioned fish using an automatic fishing machine [J]. *Aquaculture*, 2012, 330-333(none):136-141.DOI:10.1016/j.aquaculture.2011.12.002.
- [13] Loneragan, Neil R; Jenkins, Gregory I; Taylor, Matthew D. Marine Stock Enhancement, Restocking, and Sea Ranching in Australia: Future Directions and a Synthesis of Two Decades of Research and Development [J]. *Reviews in Fisheries Science*, 2013, 21(1a4).
- [14] Yuan-Wei Du; Yi-Ning Huang. Evaluation of marine ranching socio-ecological system resilience in China [J]. *Regional Studies in Marine Science*, 2024, Vol.77: 103658
- [15] Taylor M D, Chick R C, Lorenzen K, et al. Fisheries enhancement and restoration in a changing world [J]. Elsevier, 2017. DOI:10.1016/j.fishres.2016.10.004.