

# Bibliometric Knowledge Mapping of Fishery Biology on Big Data

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**Abstract:** This paper reviews the research literature of fishery biology, summarizes the previous description of the connotation and characteristics of fishery biology, discusses the research of fishery biology in the development mode, evaluation system and evaluates the existing research results on this basis. The purpose of this research is to help researchers understand the key knowledge, evolutionary trends and research frontiers of current research by knowledge mapping. Using CiteSpace literature methodology, this study analyzed the data of the science network database, and found that: One is the development of the research field has experienced three stages, and some representative key scholars and key documents have been recognized; the other is the co-occurrence of citations and keywords in the public knowledge map of literature illustrates the hot issues in this aspect. The challenges posed by visualizing big data today are different. At the same time, the theoretical model, structure and structural dimension are still debated. This is a direction that researchers need to continue their studies in the future.

**Keywords:** Knowledge mapping, Big data, Bibliometric analysis, Fishery Biology

## 1 INTRODUCTION

Looking back on the history of fishery development, from 1978 to 2015, the proportion of fishery in the total output value of agriculture, forestry, animal husbandry and fishery increased from 1.58% to 10.16% [1], and the added value continued to expand, and the impact of fishery on the development of agricultural economy was deepening. However, while making achievements, there are many problems in the development of fishery production. There is a serious problem of low resource utilization efficiency in the traditional fishery production mode [2]. 1 ton of water is used to produce wheat output value USD 0.3 is used for industrial output value of USD 14, but only USD 0.07 is used for traditional fish farming. However, environmental pollution, engineering construction and natural disasters have caused the destruction of fish spawning grounds [3], feeding grounds and migration routes, resulting in sharp contradictions between resource environment and fishery production. In addition, in the current context of globalization, countries are increasingly competitive in the development of resources on the high seas, which has increased the rigid constraints of resource environment on fishery production activities [4]. Countries are faced with the need to establish a policy support system that meets the requirements of the economic development of fishery biology and

build a fishery biology agricultural industrial system [5]. Fishery is an important component of modern agriculture. Speeding up the transformation of the development mode of fishery biology and taking the path of coordinated development of economy and ecology is a way out for the development of fishery biology. In the late 1980s, especially since the beginning of the 21st century, the research on fishery biology by scholars from various countries has been increasing [6]. On the basis of reviewing the existing research literature of fishery biology, according to the existing research logic and research content, summarize the research on the development experience of fishery biology in developed countries, then discuss the research on the development model and evaluation system of fishery biology [7], and finally evaluate the existing research results.

## **2 DATA SOURCES AND RESEARCH METHODOLOGY**

### **2.1 Data Sources**

In our study, we used the Web of Science (WOS) as a data source. WOS integrates the Science Citation Index (SCI), the Social Sciences Citation Index (SSCI), and the Arts and Humanities Citation Index (A and HCI) with the Conference Institute's Citation Index (CPCI-SSH) [8]. It provides citation index data and is the deepest and most comprehensive database in the world. Different from large databases such as EBSCO, Springer and WillieBlackwell, WOS database covers all the source journals of SSCI, and its sub-databases enjoy high authority in the academic world.

### **2.2 Research Methodology**

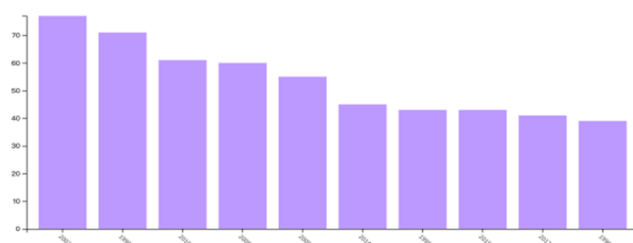
Citespace was used to analyze the age and keywords in fishery biology literature, and the high frequency keywords were calculated. CiteSpace knowledge visualization software is a multi-dimensional, temporal and dynamic knowledge mapping tool, developed by Professor [9] from Dressel University. Through the analysis and understanding of graphs, this software can transform abstract data into graph expression, so that users can intuitively see the relevant information of the corresponding research field in the research field that has mastered the knowledge characteristics of structural relations and evolution laws. CiteSpace 6.1.6 is used to analyze the literature materials selected for this article. Firstly, the literature of key nodes was sorted out through co-citation analysis, and the research hotspots and frontiers of fishery biology were analyzed through clustering and burst detection. Then, the knowledge map of the research evolution trend in the field of fishery biology was drawn, and scientific analysis and research were carried out [10]. Finally, it analyzes the internal relation between literary disciplines and the coupling relation of literature.

### 3 DATA ANALYSIS

#### 3.1 Literature Analysis

##### 3.1.1 Annual Volume Analysis

To some extent, the research status of this field at a specific stage can be reflected by the annual overall distribution of literature. In addition, an important indicator of research output is the total number of papers published each year. CiteSpace was used to extract annual data from WOS data, analyze the overall research trends in the field of fishery biology, and obtain the number of documents used in the time chart. According to the trend of the number of publications, the development of fishery biology research is growing year by year, as shown in Figure 1.

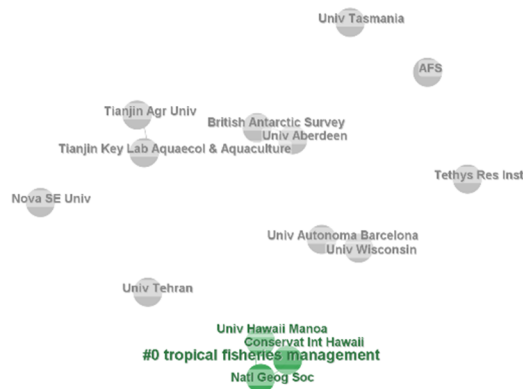


**Figure 1:** Distribution Map of Annual Total Literature in Fishery Biology

According to the trend of the number of publications, the development of e-commerce research is divided into three stages: 1) Stage of initial; 2) Stage of slow; 3) Stage of development. 2008-2009, it was the initial research phase, with or without several papers published each year. It was a slow development stage from 2010 to 2014. The number of articles published every year began to grow, sometimes it was shrinking. The number of published papers increased from 6 in 2011 to 11 in 2014. The rapid development stage of article publishing was in 2015 and the number of articles published every year which showed an obvious trend of rapid growth. The number of published papers decreased from 11 in 2014 to 10 in 2021.

##### 3.1.2 Institutional Analysis

We extracted institutional data from WOS, and the top ranked item by citation counts is Univ Tasmanla. The second one is AFS. The third is Tianjin Agr Univ. The 4th is British Antarctic Survey Univ Aberdeen. The 5th is Tianjin Key Lab Aquaecol & Aquaculture. The 6th is Nova SE Univ. The 7th is Tethys Res Inst. The 8th is Univ Autonoma Barcelona. The 9th is Univ Wisconsin. The 10th is Univ Univ Tehran, as shown in Figure 2.



**Figure 2:** Top 10 Institutions in the Field of Fishery Biology

### 3.1.3 Country Analysis

We extracted country data from WOS, and the top ranked item by citation counts is Iran. The second one is Canada. The third is China. The 4th is England. The 5th is Scotland. The 6th is USA. The 7th is Australia. The 8th is Spain. The 9th is Italy, as shown in Figure 2.



**Figure 3:** Country in the Field of Fishery Biology

### 3.1.4 Key Scholars Analysis

Scholars are leading the way in the field of research [11]. The frequency of author's citation can be used as a measure of author's influence and reveal the attention degree of author in the research field. The top ranked item by centrality Mackenzie, Simon. The second one is Goetz, Frederick William . The third is Pecl, Gretta T. The 4th is Audzijonyte, Asta. The 5th is Bearzi, Giovanni. The 6th is Morgan, M Joanne. The 7th is Franzin, William G. The 8th is Bai, Dong-Qing. The 9th is Xu, Hai-Long. The 10th is Winkler, Kathryn.





Figure 4: Analysis of Key Scholars in the Field of Fishery Biology

### 3.2 Keyword Clustering Analysis

Research hotspots results show that the highest-ranked projects in the field of fishery biology research are exploited fish population[12], cod gadus morhua, participatory research, gene expression, life history, determine population structure, flounder paralichthys olivaceus, functional genomics, sustainable fishing, reef fish. Keyword co-occurrence is another method to detect research hotspots. It is used CiteSpace to generate a keyword co-occurrence matrix and built a keyword co-occurrence network to identify research hotspots in the field, as shown in Figure 5.

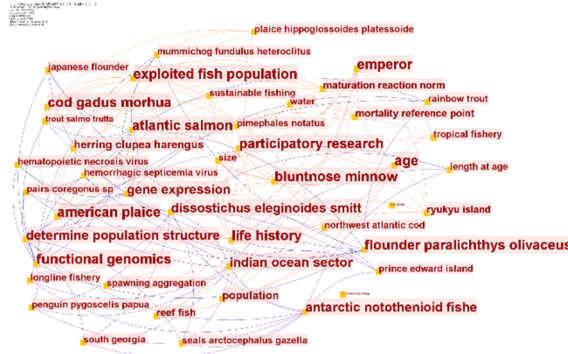
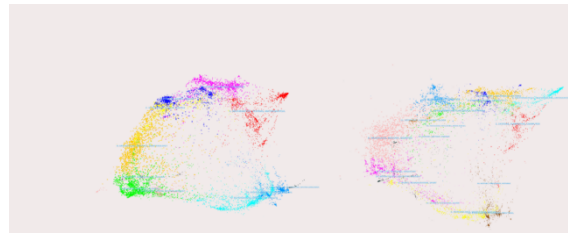


Figure 5: Keyword Clustering Graph of Fishery Biology

### 3.3 Disciplinary dual-map Overlay Analysis

Subject double graph superposition analysis can make use of the coupling relation of literature to analyze the internal relations among various subjects in the literature[13]. Figure 6 is obtained by overlaying and simplifying data from the fisheries biology literature using the Z-Score

algorithm. The journal Double Chart overlay is used to look at two common research hotspots, where the thickness of the lines indicates the degree of interconnectedness between the disciplines. Area 1 includes the subject relation of the cited literature, and Area 2 includes the subject relation of the cited literature, as shown in Figure 6 below.



**Figure 6:** Disciplinary Dual-Map Overlay of Fishery Biology

## **4 MONTE CARLO SIMULATION**

Monte Carlo Simulation is often used to verify the validity of the results and analyze specific models to a certain extent. This widely used data processing method was called the "operating model approach" DM in the early days.

### **4.1 Monte Carlo Introduction**

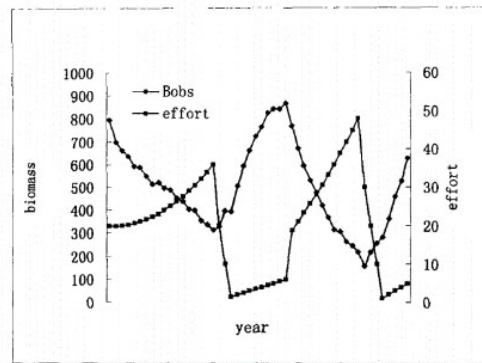
Monte Carlo simulation [14], also known as random simulation, sometimes also known as statistical modeling, is a mathematical simulation method for people to analyze machine events. It uses different agents to reflect the tourism phenomenon of the random process. It is suitable for solving some complex problems that are difficult to be solved by conventional mathematical methods in mathematics, physics, biology, engineering technology, and production management. The emergence and development of the grab machine, especially the exponential growth of the computer's back-calculation speed greatly reduces the time of cross-arm calculation, thus promoting the development and popularization of computer simulation technology. More and more practical problems are solved by random sampling tests, Monte Carlo simulation has also become a new and important branch of computational mathematics.

### **4.2 Application of Monte Carlo simulation in fishery**

Monte Carlo transverse simulation is often used to test the validity of the results and to analyze the specific model and manufacturing quantity to a certain extent [15]. At present, it has been widely and systematically applied in the catch-at-age analysis. Monte Carlo simulation was called the "operating model approach" in the early days, as shown in Figure 7. The method is as follows:

1. Establish an operating model. The operation model should conform to the actual situation and be a comprehensive description of the research object. The operation model should contain as many characteristics of the target population as possible, such as the dynamic changes of the population. Age structure, spatial structure, various growth parameters, process error, observation error, etc.

2. Determine the evaluation model. The evaluation model is a description of a certain aspect of the research object. In general, the evaluation model is only a part of the model. If the operating model can include age structure parameters, the evaluation model can be a model without age structure.



**Figure 7:** Simulated biomass and effort data set of scenario where "Bobs" is the observed biomass of the simulated fishery scenario and "effort" shows as the observed effort data generated by simulation

## 5 RESULTS

In this paper, we use the bibliometrics method to make a statistical analysis of the annual journal, research institution, main author, keywords, introduction and other contents of the article. The research hotspots, research frontiers, and evolutionary trends in the field of fishery biology were detected by reference analysis, keyword clustering algorithm, burst detection algorithm, and Z-score algorithm providing key knowledge reference for related researchers.

A document measurement method based on a knowledge graph. The visual analysis method is adopted, based on the information atlas. A knowledge graph in bibliometrics is a graphical representation of the relationship between the development process and knowledge structure through the knowledge domain. The current research results have realized the need for scientific and effective evaluation of the development model of fishery biology, and have conducted comprehensive consideration and preliminary exploration of economy, society, and ecology from the perspective of fishery ecology or marine ecology, but the focus on fishery biology is slightly insufficient at the economic level. In fact, as a part of the agricultural industrial system, fishery biology has characteristics that other industries do not have, and its influencing factors and effect reactions are also different from other economic systems. The evaluation of the development model of fishery biology should be set up at different levels for different product types, to conduct a systematic evaluation. In the existing literature, the establishment of an evaluation system and evaluation model is slightly weak, and there is no major innovation in research methods.

Our research shows that as long as the population is fully developed, the model can correctly describe the resource status of the population. The Monte Carlo model is widely used in practice, and its function is mainly to protect the fishery population and make rational use of biological

resources. In terms of biological research, determine the biological parameters of the research object, and in terms of fishery management, determine the resource status of the fishery population to provide decision-making basis for fishery management.

## 6 CONCLUSIONS AND LIMITATIONS

The following is a discussion of research topics and the views of leading scholars in the field of fishery biology. The keyword clustering diagrams in Figures 4 and 5 show that the research topics of fishery biology are mainly concerned with the following. By analyzing the literature, it can be concluded that many factors affect the operation and transaction of fishery biology. The mode of the exploited fish population, cod gadus morhua, participatory research, gene expression, life history, determine population structure, flounder paralichthys olivaceus, functional genomics, sustainable fishing, and reef fish are the main factors.

The research field of fishery biology has become a research hotspot for current scholars. At present, the research field of fishery biology has become a research hotspot with fruitful research results and many representative scholars and theoretical articles published. However, because of the current research status, the research in various aspects of fishery biology is not complete and perfect, the research methods are also lacking, and the development of fishery biology theory is lagging. Therefore, it is necessary to broaden the research horizon and continue the in-depth research based on further research and observation.

Bibliometrics is a scientific and effective library and information research method to make statistics, descriptions, and predictions of academic status and development trends. But the measure of science and technology is undoubtedly the quantity and quality of scientific literature. This study was conducted based on WOS database, and the results are objective and fair. However, due to the limitation of a database, the data is not comprehensive enough, and some databases do not support catalog downloading. So there might be some bias in the results. In future studies, Data Mining technology can be used to expand the scope of source data collection and improve the quantity and quality of articles.

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Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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