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Determination Method of Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

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Abstract: With the continuous progress of human society and the increasingly severe environmental problems, people begin to attach importance to the sustainable development strategy. The unbalanced distribution of China's marine resources, large regional differences, and serious pollution determine that in the actual development, we should consider the coordination between regions and ecological factors to comprehensively control them, so as to maximize economic benefits. This paper first introduces the relevant knowledge of the combination of principal component analysis and grey system theory, and then expounds the fusion principal parameter pre estimation method and multiple linear regression method, and verifies the effectiveness and applicability of the model with examples. Finally, the experimental results show that the overload threshold of marine resources and environment based on the genetic analysis method is relatively accurate. On the premise that the loss of original data is minimal and the loss of linear transformation and other parts of data is minimal, the multidimensional variable of original data is replaced by the transformation dimension method, that is, a few comprehensive transformations.

1. Introduction

Marine resources are the material basis for the survival of human society. With the economic development and the improvement of human living standards, people are increasingly sensitive to the marine environment [1-2]. In China, due to the influence of traditional concepts, natural environment and other factors, serious ecological environment deterioration and pollution problems have been caused. On the other hand, the pressure brought by population growth and increased demand for resources has led to a situation of supply exceeding demand in coastal areas [3-4].

Domestic scholars have studied the fusion principal component analysis from different angles. After comprehensively comparing the advantages and disadvantages of various methods, some scholars put forward the problems that should be paid attention to when adopting this method [5-6]. There are also scholars who determine the overload threshold through multi index composite evaluation. Some scholars have established a fuzzy clustering model based on the domestic and foreign cooperative load overload limit, critical load limit and the coordinated effect of target area and area under the coordinated state, and analyzed and studied its advantages. Some scholars determine the function of the road system by analyzing and comprehensively utilizing the traffic load effect of the road system. Some scholars put forward a new idea in the construction of fuzzy evaluation index system based on the combination of principal component method and hierarchical correlation degree batch method, that is, integrating the overload threshold functions such as power and bearing capacity into the hybrid timing model, and weighting the weight [7-8]. Therefore, based on the principal cause analysis method, this paper studies the determination of the overload threshold of marine resources and environment carrying capacity,

In this paper, the application of fusion principal component analysis in solving regional spatial bearing capacity is developed. Firstly, it introduces the relevant literature, theoretical research status and calculation methods at home and abroad. Secondly, it expounds the principles and ideas of comprehensive integrated evaluation index system and fusion model construction based on principal component analysis. Then, it carries out modeling and experimental verification of specific cases in combination with actual cases, discusses and summarizes the results, and finally puts forward conclusions.

2. Discussion on Determination Method of Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

2.1. Carrying Capacity of Marine Resources and Environment

The overload threshold of marine resources and environmental carrying capacity refers to the capacity that the ocean can provide to meet human needs and sustainable economic and social development to the maximum extent when its scale, shape and development speed are limited at a certain time [9-10]. After determining a specific target in practical application, it is necessary to consider whether the target will be utilized. For a specific environmental carrying capacity overload threshold, it is necessary to compare and analyze it with the expected target at a certain time, so as to obtain the results. The carrying capacity of marine resources and environment can generally be divided into two parts: natural resources and ecological environment. The former mainly includes soil and water loss and pollution control. The latter needs to consider the impact of human activities on the natural environment and the irreversible losses caused by human factors, such as sea level rise and biodiversity reduction caused by global warming. There are three aspects in the practical application of this threshold: first, different types of marine resources have different characteristics and applicability. Second, each region has different natural resource conditions. Third, each region interacts with each other to form its internal system. For an area, the overload critical value of various resources and environmental carrying capacity in the sea area will gradually increase as the target causes certain damage or damage to the land [11-12].

2.2. Factors Affecting the Overload of Marine Resources and Environment Carrying Capacity

As shown in Figure 1, the factors of overload of marine resources and environment mainly include the following aspects:

(1) Natural factors. Including climatic conditions. Climate change and geological disasters are

the most direct and decisive factors that affect the sustainable development and utilization rate of marine resources. In different regions, such as typhoons and floods, they play a great role in sea winds and waves. Therefore, it is of great significance to study the law of tidal change in coastal areas and its close relationship with maritime traffic. Through calculation and analysis under the conditions of high temperature, low wind speed and concentrated rainfall, it can be seen that climate change will lead to serious eutrophication of sea water in the coastal areas, and the water and soil loss in the coastal zone caused by the ocean current in the near sea area can not be ignored. The sea water invasion has a great impact on the terrestrial ecosystem, thus reducing the carrying capacity of marine resources and environment [13-14].

(2) Development factors. Among them, the change of social and economic conditions, the overload of geographical environment and the difference of climate conditions lead to some differences in the measures taken by various regions when marine disasters occur. With the passage of time, the changes of marine ecological environment have led to changes in marine biological community, biogeochemical cycle system and social economy to a certain extent. The influence on its size and development speed mainly depends on natural factors (sea, land and airspace). With the growth of our national economy and the improvement of the living standard of residents, as well as the continuous increase of national requirements for environmental protection. The coastal area has become the only city with the world's highest level Haihe River Basin, national strategic port and other target planning and construction bases in China's largest sea area, while the inland area cannot realize marine development and utilization due to the limitation of land resources [15-16].

(3) Management factors. It mainly refers to the development and utilization of marine resources, production and operation, and the development of upstream and downstream enterprises in the relevant industrial chain. These factors jointly determine the responsibilities of the whole social economy and human activities in a certain period of time.

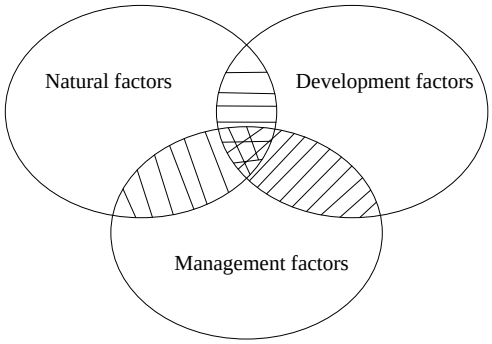

Figure 1. Combination of factors affecting Marine resources and environmental overload

2.3. Main Cause Analysis Method

The main cause analysis method is to determine the overload threshold according to the main causes of bearing capacity, and then modify it to obtain the objective function. According to the overload unbalance degree theory and dynamic response characteristics to judge the advantages and disadvantages of the system. This method can be used to solve nonlinear equations. However, in practical application, it is often affected by environmental conditions, human factors and so on, resulting in certain deviation of the results. For example, the climate in some areas is hot and humid, and the seasonal changes are too fast, which may change the calculated bearing capacity value, thus causing difficulties or even failures in data analysis. It can be divided into two categories according to the change law of time. One is nonstationary stochastic process, the other is dynamic fluctuation process under nonstationary state. It includes two modeling methods: linear regression and

non-linear fitting. For non-stationary time-varying parameters, that is to say, multiple groups of data are obtained by weighted summation of variables to establish a mathematical model. In practical application, it is necessary to consider a variety of influencing factors and various constraints to obtain a more reasonable and reliable method. This method has the advantage of comprehensively reflecting the spatial, quality and distribution characteristics of land resources. It can describe the interaction between various landscape forms and various functional areas from a macro perspective, and also analyze the relationship between the interaction between land use structure and environmental conditions and its great impact on the ecological environment [17-18]. Fig. 2 is the main genetic structure diagram of genetic analysis method.

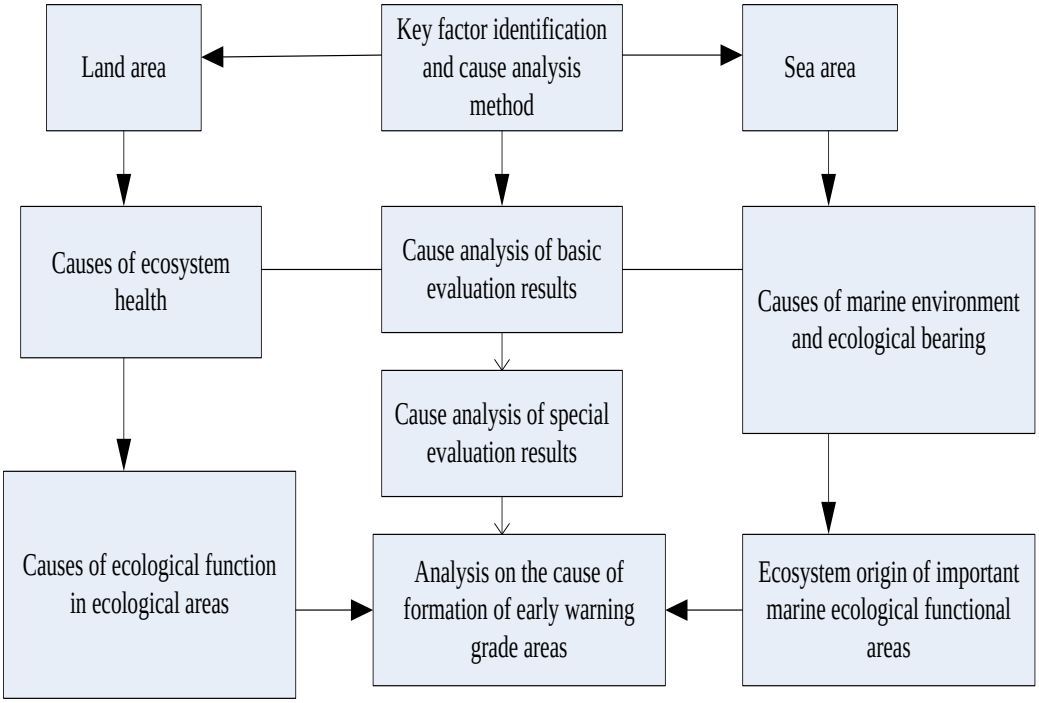

Figure 2. Main genetic structure diagram of the genetic analysis method

In the analysis of overload criticality, we usually use two basic principles, one is theoretical derivation, that is, using mathematical methods to calculate. The second is to deal with practical problems. First of all, we should take into account all kinds of situations encountered in reality. For example, environmental conditions, climatic conditions and other factors, and then through comprehensive comparison, an index system that is most suitable for the climatic conditions and resource carrying capacity of the research area is obtained. Finally, analysis and calculation are carried out according to this system and conclusions are drawn, and then theoretical methods are further improved on this basis.

$$\lambda_{i1} \geq \lambda_{i2} \geq \lambda_{i3} \ldots \geq \lambda_n \tag{1}$$

$$\sum_{r=1}^{n} \lambda_{r/m} \geq 0.6 \sim 0.8 \tag{2}$$

When solving the problem, the effective boundary can be defined as that the equilibrium state is unstable or has a change trend after the constraints are met. That is, the parameter initialization result can be obtained when the nonlinear requirements in the following formula are met. The formula is the overload threshold corresponding to the limit value of each point of the system.

3. The Experimental Process of the Method for Determination Method of Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

3.1. Method and Process for Determining Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

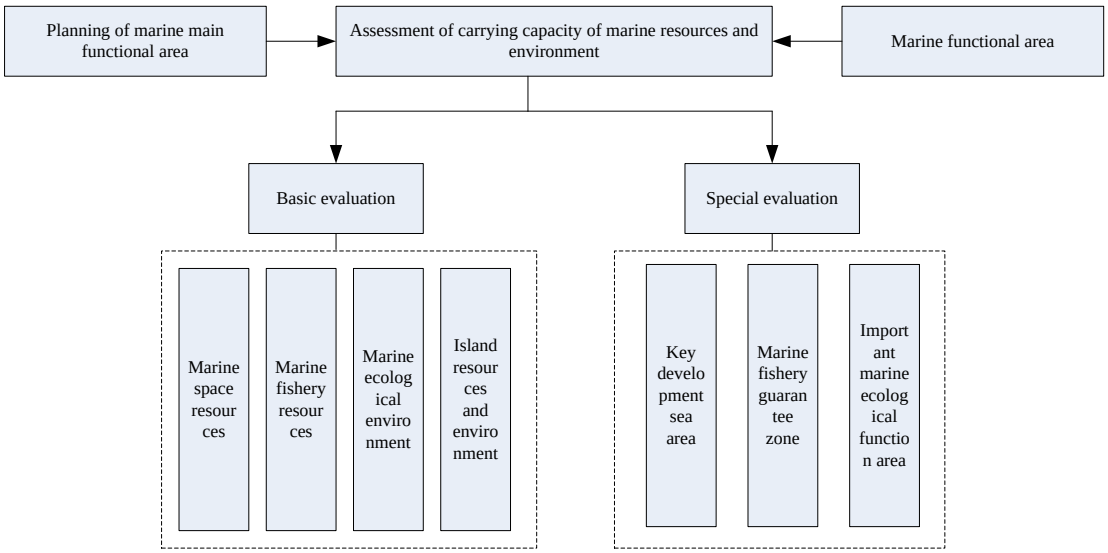

Figure 3. The determination process of overload capacity threshold of Marine resources and environment based on genetic analysis

Principal cause analysis (PCA) is a relatively traditional method, which can be used to build mathematical models of practical problems and convert them into numerical models for calculation objects. To some extent, this method can solve the problem of difficulties caused by different fixed values or assumptions when dealing with marine environmental problems in complex and changeable, multi variable and multi change situations in reality. But because the theory and technology are relatively mature and widely used, they are still not widely used in real life. Principal cause analysis is an advanced multivariate statistical prediction method. The method flow for determining the overload threshold of marine resources and environment can be seen from Fig. 3:

(1) According to the regional geological data, the influence of natural factors such as ocean current and rainfall on the area is analyzed and studied;

(2) The change law of each parameter under the overload critical condition and the effect of each parameter in practical application are analyzed and calculated, and on this basis, the fusion main cause judgment index system is established.

3.2. Determination Method Test of Overload Threshold of Marine Resources and Environment Carrying Capacity

Firstly, the carrying capacity of marine resources and environment is tested, the overload threshold is determined, and the data is input into the software. Establish a systematic evaluation index system according to the natural conditions and socio-economic conditions of the marine area. Select appropriate samples according to the attribute of the target layer to select the overload critical point. Secondly, comprehensively analyze and compare the information of various types of marine resource units and their locations within the target area. Finally, according to the above method, the

relationship between the influencing factors is obtained, and then the model is established.

4. Experimental Analysis of the Method for Determination Method of Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

4.1. Test and Analysis of Determination Method of Overload Threshold of Marine Resources and Environment Carrying Capacity Based on Principal Cause Analysis

Table 1 is the test data of the method for determining the overload threshold of environmental carrying capacity.

Table 1. Overload threshold determination method test

Test times	R1	R2	R3	R4
1	0.23	0.44	0.45	0.42
2	0.31	0.32	0.43	0.31
3	0.42	0.52	0.42	0.22
4	0.36	0.34	0.33	0.33
5	0.42	0.52	0.21	0.42

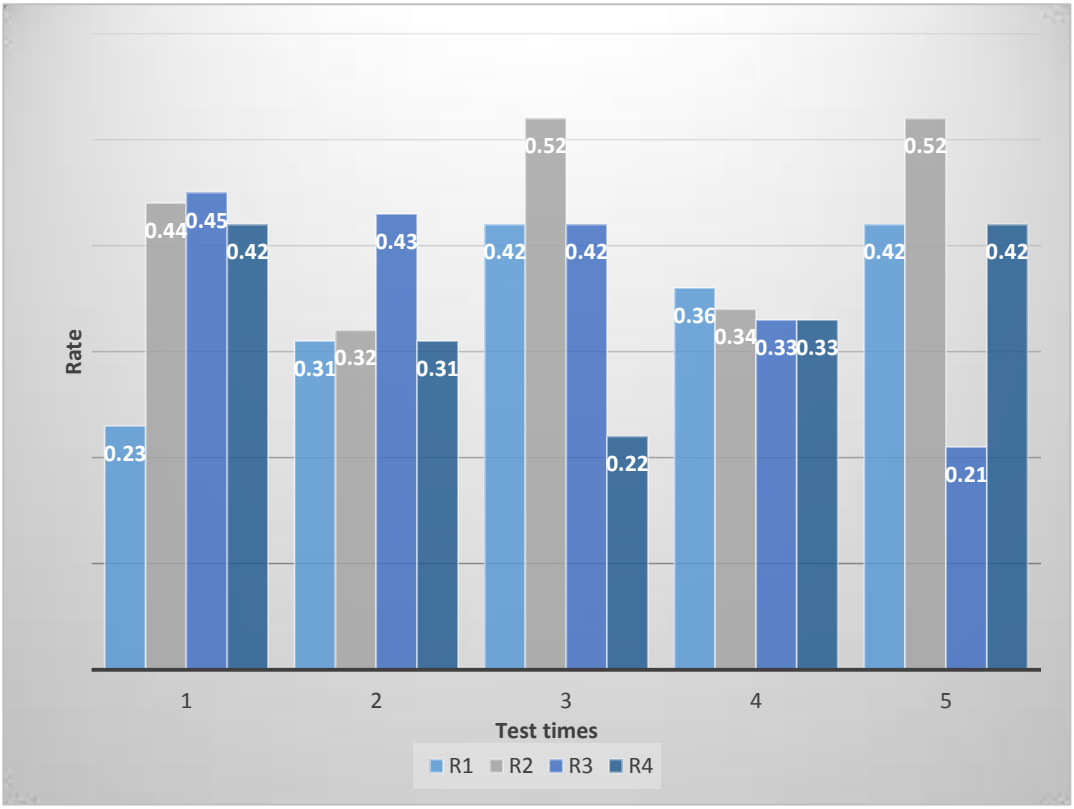

Figure 4. Determination method of environmental load capacity overload threshold

The purpose of the method for determining the overload threshold of marine resources and environment carrying capacity is to analyze the impact of active force factors on the development of marine areas under different circumstances, and how to take measures to reduce losses after problems may occur in practical application. The test mainly adopts the following methods. Based on principal component factor model. This experiment uses MATLAB software to build an

experimental platform and import it into a calculator for simulation. When using Matlab / syna to process data, initial parameters and boundary conditions need to be set first. It can be seen from Fig. 4 that the overload thresholds of marine resources and environment based on the genetic analysis method are relatively accurate. On the premise that the loss of original data is minimal and the loss of linear transformation and other parts of data is minimal, the multidimensional variable of original data is replaced by the transformation dimension method, that is, a few comprehensive transformations.

5. Conclusion

In the process of social and economic development, environmental problems have become a global problem, especially in marine resources. How to deal with the relationship between environmental protection and sustainable development has always been a topic of common concern in the world. In this paper, the fusion principal component analysis method is used as the main research method for in-depth discussion and application, and the determination method of the overload threshold of marine resources carrying capacity under the actual situation in China is discussed. Finally, some suggestions are put forward for reference to cope with the impact of geographical environment change, climate change and other factors.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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