Analysis of Research Results of SSCI Environmental Bear Capacity in Recent Twenty Years Based on CiteSpace-II

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Abstract. According to the data on Social Science Citation Index (SSCI), an international literature retrieval tool for humanities and social sciences in the past 20 years, and based on Citespace II data visualization software developed by Dr. Chen Qimei, Changjiang Scholars of Dalian University of Technology based on Java, an all-round subject knowledge graph is constructed on the research hotspots and main research fields of environmental bear capacity, academic schools and subject structures, and the relationship with neighboring disciplines. Through “a picture is better than a thousand characters”, the research on scattered environmental bear capacity will develop towards digitalization and spatial visualization on the basis of quantification, and will be presented in an image-based and interactive way. It shows the development trend and trend of a discipline or knowledge domain in a certain period of time and forms the evolution process of several research frontier fields.

1. Introduction
The world outlook of classical science holds that the essence of the world is orderly, and disorder is only a phenomenon of world affairs. The purpose of scientific understanding is to discover and master the regularity of the essence of things through chaotic phenomena [1]. However, it often leads to two extremes: One is simplification, that is, reducing complex things to simple things. Environmental bear capacity is divided into three elements: Bearer, bear object and environmental bear rate (EBR). The index of environmental bear capacity is composed of three indicators: Natural resources supporting capacity, environmental production supporting capacity and social, economic and technological supporting level [2,3].

The second is fragmentation, that is, if the nature of different levels or aspects of the cognitive objects is determined, they will be completely divided and not connected. At present, a set of environmental productivity has been formed in various types of environmental bear capacity research, such as regional environmental bear capacity, comprehensive bear capacity of resources and environment, bear capacity of resources and environment elements, etc. [4-6]. As an important index to measure the ability of environmental quality and environmental capacity to be disturbed by human production and living activities in environmental science research, it should reflect the result of a dynamic and long-term interaction and should be an open, dynamic and unfinished process.

In the middle of the 20th century, Braudel, a master of the French Annals School, put forward the theory of historical periods, which holds that historical periods can be divided into three different periods: long, medium and short [7]. Long period: Refers to some factors that have played a role for hundreds and thousands of years, such as geographical pattern, climate change, social organization, mode of thinking and cultural mentality. Long period studies the historical structure, and its restriction
on people and society is the most obvious. Medium period: The time is about several decades, which can be described by "state", "situation" and "cycle" to point out some historical factors that play a role in a long period, such as population growth, circulation analysis, national output value, etc. The short period is on the surface of historical movements, mainly studying events, phenomena and short-term activities of characters. 

In the age of information overload, facing the various kinds of environmental bear capacity research, it is necessary to comprehensively analyze the models and evaluation methods constructed and used in the literature on environmental bear capacity, explore the starting point, core literature and trend of its research, especially dig out the hidden structural factors under the situation of long period-geographical time-structure and medium period-social time-situation, so as to find the breakthrough point of environmental bear capacity research and the deeper relationship between environment and human beings. In this article, the advanced method of information technology-scientific knowledge graph is introduced. Taking all the articles published in the last 20 years included in the American SSCI as the research object, under the help of scientific knowledge graph, the overall picture, development trend and structural characteristics of the frontier progress of environmental bear capacity are objectively, scientifically, systematically and vividly displayed, and the correct research direction and breakthrough point are found.

2. Data Acquisition, Research and Drawing Graph

2.1. Data Acquisition
The data source of this study is located under SSCI precise retrieval, and many retrieval strategy experiments have been carried out. It is found that in the experiment, if we directly use the advanced retrieval interface of SSCI database to input the retrieval formula: TS=(("Bear capacity" OR bearing ) AND (Environmental OR ecological OR resource)), the retrieved research results have false detection, and many research results have no support for this research purpose. The reason is that if the above search terms are placed in other disciplines, their research contents may be quite different from the purpose of this research. In order to obtain the supporting data in the research, in the improved experiment, the above retrieval formula was limited to “Environmental Sciences & Ecology OR History OR History & Philosophy of Science” for retrieval, and 768 retrieval results were obtained. Through the verification of the retrieval results by authoritative publishing agencies and authors, the detection rate and accuracy rate were both high. In view of the three types of literatures, ARTICLE, PROCEEDINGS ARTICLE and REVIEW, we can obtain the research status of environmental bear capacity from the perspective of scientific research. Therefore, the types of literatures were finally limited to the above three types, and 702 usable data were obtained, of which 658 were ARTICLE type studies, accounting for 93.73% of the total. 44 articles of PROCEEDINGS ARTICLE type, accounting for 6.27% of the total; There were 41 REVIEW type literatures, accounting for 5.84% of the total. This article sets the time range from 1994 to 2014 (retrieval time is October 28th, 2014). Although the data in 2014 are incomplete due to the delay of database update, the existing data obviously play an important role in obtaining the latest research topics. Therefore, this study also takes the incomplete data in this year as one of the data sources, thus constituting the analysis of SSCI research results on environmental bear capacity in the past 20 years.

2.2. Research Methods
In this study, the knowledge graph analysis software Citesease II is used as the analysis tool, and the embedded keyword co-occurrence and literature co-citation analysis methods are mainly used as the basic analysis methods. The method of keyword co-occurrence analysis is the direct statistic of the published literatures. What we are looking for is the topic that the current article focuses on. It reflects the focus and hot spots after the trend is formed. The literature co-citation analysis rule shows the focus of people's current attention by analyzing the citation of previously published articles. It is more suitable for finding the paradigm of mature disciplines and can identify the classic literatures
representing the knowledge base and research frontier in a certain discipline field.

2.3. Drawing of Knowledge Graph

702 research results were imported into CiteSpace II to draw the knowledge graph required by the project. The parameters are set as follows: Time Slicing is set to 1994-2014, the length of a single time partition (# Years PerSlice) is set to 1 year, the source of subject words is selected as Title, Abstract and Descriptors and Identifiers, the threshold value is the first 50 high-frequency words, the term type is selected as Noun Phrases, the node type is selected as Keywords or Cited Reference. Run the program to obtain the keyword co-occurrence knowledge graph (as shown in Figure 1) and the literature co-citation knowledge graph (as shown in Figure 3). In the keyword co-occurrence graph, each node represents a keyword, the node size indicates the frequency of keyword occurrence, the connection between nodes indicates the co-occurrence relationship between keywords, the annual ring structure of nodes reflects the occurrence time of a certain keyword, and the color tone changes from cold to warm to indicate the time from far to near. In the knowledge graph of literature co-citation, each node represents a literature, the node size represents the citation frequency of the literature, and the connection lines between nodes represent the co-citation relationship between literatures.

3. Analysis on the Overall Research Situation of Environmental Bear Capacity

From 1994 to 2014, 72 research results were produced in the study of environmental bear capacity. After 8 years of fluctuating growth (1994 to 2002), the research results showed a stable growth trend since 2003 (as shown in Figure 1). In 2013, the number of 77 articles reached its peak, which shows that the research on environmental bear capacity has become a hot topic of common concern to scholars. Statistics show that 73 countries (regions) have paid some attention to this in the past 20 years. Among them, the United States, Britain, China, Canada and Australia have paid the highest attention, especially the United States, with 293 articles, accounting for 41.74% of the total articles, occupying the leading position in the research on environmental bear capacity. China ranked third with 53 articles, accounting for 7.55% of the total articles. Although China occupies an important position in the international environmental bear capacity research, it is far from the United States. The reason why these countries perform so well is inseparable from the contribution of their research institutions. Of the 871 participating agencies, the top five institutions according to the number of articles published are the University of California in the United States (22), the Chinese Academy of Sciences in China (18), the University of London in the United Kingdom (15), Florida State University (13) and Colorado State University in the United States (12). The articles published by various institutions finally came from specific authors. 702 research results were published by 1,906 scholars, and of which MANNING RE of University of Vermont in the United States was the first to publish 6 articles. DOWSLEY M of Canada's Lake Head University came in second with 4 articles. Among many research researchers, Chinese researchers also performed well. Among them, ZHAO JZ of the Chinese Academy of Sciences and ZHANG DD of Peking University took two seats among the 13 authors who ranked third with 3 articles. In addition, publications from various sources provide an important platform for the promotion and knowledge sharing of environmental bear capacity research. All 16 source publications published in 186 journals and with more than 10 articles published have 297 articles, accounting for 42.31% of the total number of articles published, that is to say, journals that account for less than one tenth of the total number have published nearly half of the total number of articles published, and the phenomenon of literature concentration is very significant. 16 kinds of source publications, including environment-related eco-economics, urban planning, population, land use, tourism management, resources, sustainable development, and other fields, provide important research on environmental capacity support as shown in figure 2.
4. Analysis of Key Areas of Environmental Bear Capacity

High-frequency vocabulary is a natural language vocabulary that expresses the concept of literature theme. It is a collection of high-frequency vocabulary with a large number of academic research results in a long-time domain in the field of academic research. It can reveal the overall content characteristics of research results, the internal relations between research contents, the research frontier and development trend of academic research. Because the keywords or title words of a literature are the condensation and refinement of the core content of the article. Therefore, if a keyword or title word appears repeatedly in the literature in its field, it can reflect that the research topic represented by the keyword or title word is the research focus in this field. However, because a single keyword often has a low degree of specificity, it is easy to reduce the fineness of the analysis content by simply examining the research hot topics, thus it cannot reveal the research hot topics from a more microscopic and specific perspective. However, keyword co-occurrence analysis can effectively overcome this defect by restricting each other among the common keywords. Keyword co-occurrence analysis is one of the commonly used content analysis methods in metrology. Based on the principle that two (more) keywords appear at the same time, keyword co-occurrence analysis can aggregate literature resources with similar topics and contents. Therefore, this study combines...
high-frequency words and their co-occurrence relations to identify the key areas of environmental bear capacity research. Figure 3 is a keyword co-occurrence knowledge graph obtained by Citespace. Combined with the co-occurrence relationship between the high-frequency word list in Table 1 and each high-frequency word in the graph, the C1-C7 cluster of environmental bear capacity research can be obtained through manual processing.

C1: Study on Elements of Environmental bear capacity. The focus includes population, climate, land use, etc.
C2: Research on Resource Bear Capacity.
C3: Study on Ecological Bear Capacity.
C4: Study on the Relationship between Environmental Bear Capacity and Economic Resources.
C5: Sustainable Development Research. Mainly includes environmentally sustainable development, economic sustainable development, sustainable development quality research.
C6: Research on Environmental Protection and Governance.
C7: Study on Environmental bear capacity in Various Countries.

![Figure 3. Keyword co-occurrence Knowledge Graph (Nodes=651, Links=908).](image)

| No | Keywords                      | Occurrence time (earliest occurrence time within statistical range) | Word frequency | Emergent degree |
|----|--------------------------------|-----------------------------------------------------------------|----------------|----------------|
|   | Term                        | Year |   |
|---|-----------------------------|------|---|
| 12| industrial-revolution       | 1995 | 2 |
| 13| Land management             | 1995 | 1 |
| 14| land allocation             | 1995 | 1 |
| 15| management                  | 1996 | 66|
| 16| environment                 | 1996 | 35|
| 17| population                  | 1996 | 34|
| 18| ecology                     | 1996 | 18|
| 19| ecological economics        | 1996 | 13 |
| 20| ecosystem                   | 1996 | 11|
| 21| fisheries                   | 1996 | 8 |
| 22| migration                   | 1996 | 3 |
| 23| mobile                      | 1996 | 1 |
| 24| carrying-capacity           | 1997 | 48|
| 25| economics                   | 1997 | 19|
| 26| ecotourism                  | 1997 | 6 |
| 27| human carrying capacity     | 1997 | 1 |
| 28| climate change              | 1998 | 23|
| 29| city                        | 1998 | 8 |
| 30| carrying capacity           | 1998 | 3 |
| 31| climate-change              | 1999 | 21 |
| 32| ecological footprint        | 1999 | 33|
| 33| governance                  | 1999 | 15|
| 34| ecosystems                  | 1999 | 10|
| 35| united-states               | 2000 | 28|
| 36| environmental justice       | 2001 | 14|
| 37| environmental history       | 2001 | 3 |
| 38| cities                      | 2002 | 10|
| 39| adaptation                  | 2002 | 9 |
| 40| sustainable tourism         | 2002 | 8 |
| 41| ecological footprints       | 2002 | 2 |
| 42| community                   | 2003 | 10|
| 43| co-management               | 2003 | 9 |
| 44| biodiversity                | 2003 | 7 |
| 45| conservation                | 2003 | 7 |
| 46| ancient feeding ecology     | 2003 | 1 |
| 47| china                       | 2004 | 20|
| 48| race                        | 2004 | 5 |
| 49| land-use                    | 2005 | 18|
| 50| ecosystem services          | 2005 | 16|
| 51| capacity                    | 2005 | 4 |
| 52| pollution                   | 2006 | 15|
| 53| resources                   | 2007 | 17|
| 54| ethics                      | 2007 | 7 |
| 55| water                       | 2007 | 5 |
| 56| tourism                     | 2008 | 15|
|    | social-ecological systems  | 2008 | 9 |
From Table 1, it can also be seen that the two keywords of climate-change and ecological economics have strong prominence. Figure 3 shows the prominence time distribution of these two keywords. From this, it can be seen that climate change received a sharp increase in scholars' attention in 2013 and ecological economics from 1996 to 2003, indicating that climate change is one of the frontiers of environmental bear capacity research in the past two years.

Figure 4 is a time zone graph of keywords. Through the time zone graph, the progressive relationship of the occurrence time of the fields represented by keywords can be understood. As can be seen from Figure 4, environmental bear capacity received more intensive attention in 1995. At the same time, agricultural land, population migration, fishery, sustainable development and economic growth also received more attention during this period. The issue of climate change was first paid attention to in 1998. At the same time, the issue of environmental governance was also raised during this period. In 2001, the study of environmental history came into the attention of scholars. Subsequently, sustainable tourism resources and ethnic issues were also raised by scholars. In 2005, land use once again became the focus of scholars. In recent years, the problems of gas emission, urbanization, rural population migration and air pollution have become the research fields that scholars focus on. In particular, in 2014, the issue of environmental history became a more important field after 2001, which attracted the attention of scholars.

Top 2 keywords with Strongest Citation Bursts

| Keywords                     | Year | Strength | Begin | End   | 1994 - 2014 |
|------------------------------|------|----------|-------|-------|-------------|
| climate-change               | 1994 | 3.4817   | 2013  | 2014  |             |
| ecological economics         | 1994 | 3.3138   | 1996  | 2003  |             |

Figure 4. Highlighting keywords.
5. Analysis of Classical Literature on Environmental Bear Capacity

The classical literatures in the study of environmental bear capacity are composed of those literatures with high citation frequency, which provide an important knowledge basis for the study of environmental bear capacity. Figure 5 is a knowledge graph of the literatures cited together, and figure 6 is an overlapping knowledge graph of this field. Combined with the literatures cited more than 100 times listed in figure 6, figure 7 and Table 2, these problems form a solid knowledge foundation for environmental bear capacity.

![Knowledge Graph of Keyword Time Zone](image1)

Figure 5. Knowledge Graph of Keyword Time Zone.

![Co-citation graph of literature](image2)

Figure 6. Co-citation graph of literature (Nodes=970, Links=862).
Figure 7. Overlapping Knowledge Graph of Environmental Bear Capacity.

Table 2. Classical literatures cited more than or equal to 100 times.

| Literature Title                                                                 | Author                          | Periodicals                         | Year of Publication | Number of Citations |
|----------------------------------------------------------------------------------|---------------------------------|-------------------------------------|---------------------|---------------------|
| National natural capital accounting with the ecological footprint concept        | Wackernagel, M; Onisto, L;      | ECOLOGICAL ECONOMICS                | 1999                | 279                 |
| Income, inequality, and pollution: a reassessment of the environmental Kuznets Curve | Torras, M; Boyce, JK             | ECOLOGICAL ECONOMICS                | 1998                | 221                 |
| Spatial sustainability, trade and indicators: an evaluation of the 'ecological footprint' Environmental concern: Conceptual definitions, measurement methods, and research findings | van den Bergh, JCJM; Verbruggen, H | ECOLOGICAL ECONOMICS                | 1999                | 199                 |
| The effects of urban patterns on ecosystem function                              | Fransson, N; Garling, T         | JOURNAL OF ENVIRONMENTAL PSYCHOLOGY INTERNATIONAL SCIENCE REVIEW ENVIRONMENTAL & RESOURCE ECONOMICS ENVIRONMENTAL MODELLING & SOFTWARE ECOLOGICAL APPLICATIONS | 1999 | 185 |
| Estimates of the damage costs of climate change - Part II. Dynamic estimates     | Alberti, M                      | JOURNAL OF ENVIRONMENTAL PSYCHOLOGY INTERNATIONAL SCIENCE REVIEW ENVIRONMENTAL & RESOURCE ECONOMICS ENVIRONMENTAL MODELLING & SOFTWARE ECOLOGICAL APPLICATIONS | 2005                | 164                 |
| Modelling with stakeholders                                                       | Voinov, Alexey; Bousquet,      | ENVIRONMENTAL MODELLING & SOFTWARE ECOLOGICAL APPLICATIONS | 2010                | 143                 |
| Principles for the conservation of wild                                           | Mangel, M; Talbot, LM; Meffe, GK; Agardy, MT; | ENVIRONMENTAL MODELLING & SOFTWARE ECOLOGICAL APPLICATIONS | 1996                | 143                 |
| Living Resources | Authors | Journal | Year | Page |
|-----------------|---------|---------|------|------|
| | Alverson, DL; Barlow, J; Botkin, DB; Budowski, G; Clark, T; Cooke, J; Crozier, RH; Dayton, PK; Elder, DL; Fowler, CW; Funtowicz, S; Giske, J; Hofman, RJ; Holt, SJ; Kellert, SR; Kimball, LA; Ludwig, D; Magnusson, K; Norse, EA; Northridge, SP; Perrin, WF; Perrings, C; Peterman, RM; Rabb, GB; Regier, HA; Reynolds, JE; Sherman, K; Sissenwine, MP; Smith, TD; Starfield, A; Taylor, RJ; Tillman, MF; Toft, C; Twiss, JR; Wilen, J; Young, TP | ECOLOGICAL ECONOMICS | 1998 | 132 |
| Environmental Kuznets curves - real progress or passing the buck? A case for consumption-based approaches | Rothman, DS | | |
| Autism spectrum disorders in relation to distribution of hazardous air pollutants in the San Francisco Bay area | Windham, Gayle C.; Zhang, Lixia; Gunier, Robert; Croen, Lisa A.; Grether, Judith K. | ENVIRONMENTAL HEALTH PERSPECTIVES | 2006 | 118 |
| New methodology for the ecological footprint with an application to the New Zealand economy | Bicknell, KB; Ball, RJ; Cullen, R; Bigsby, HR | ECOLOGICAL ECONOMICS | 1998 | 117 |
| Restorative experience and self-regulation in favorite places | Korpela, KM; Hartig, T; Kaiser, FG; Fuhrer, U | ENVIRONMENT AND BEHAVIOR | 2001 | 113 |
| Who should pay for tropical conservation, and how could the costs be met? | Balmford, A; Whitten, T | ORYX | 2003 | 112 |
| Revisiting carrying capacity: Area-based indicators of sustainability | Rees, WE | POPULATION AND ENVIRONMENT | 1996 | 112 |
| Ecological footprint analysis as a tool to assess tourism sustainability | Gossling, S; Hansson, CB; Horstmeier, O; Saggel, S | ECOLOGICAL ECONOMICS | 2002 | 107 |
| Community-based participatory research: Lessons learned from the Centers for Children's Environmental Health and | Israel, BA; Parker, EA; Rowe, Z; Salvatore, A; Minkler, M; Lopez, J; Butz, A; Mosley, A; Coates, L; Lambert, G; Potito, PA; | ENVIRONMENTAL HEALTH PERSPECTIVES | 2005 | 106 |
In addition, the cited literature can reflect the research frontier of a certain topic in a certain period of time. In order to investigate the research frontier of environmental bear capacity, as shown in Table 3, this study calculated the emergence of environmental bear capacity literatures, and finally obtained 6 literatures with high cited emergence, as shown in Figure 3. Figure 6 shows the time when these literatures appeared to be cited.

### Table 3. Literature with High Prominence.

| No. | Author                                      | Time of Publication | Periodicals                  | Cited Frequency | Emergent Degree |
|-----|---------------------------------------------|---------------------|------------------------------|----------------|-----------------|
| 1   | Hardin G                                    | 1968                | SCIENCE                      | 21             | 3.31            |
| 2   | WCED                                        | 1987                | OUR COMM FUT                 | 16             | 3.15            |
| 3   | World Commission on Environment and Development | 1987               | OUR COMM FUT                 | 11             | 3.3             |
| 4   | Wackernagel Mathis                          | 1996                | OUR ECOLOGICAL FOOTP         | 35             | 3.54            |
| 5   | Wackernagel M                              | 1999                | ECOL ECON                    | 19             | 3.62            |
| 6   | Monfreda C                                  | 2004                | LAND USE POLICY              | 16             | 3.18            |

### 6. Conclusion

Through the above literature research, it is found that at present, the research on environmental bear capacity pays more attention to the ecological bear capacity of watersheds, ecologically fragile areas, cities, agricultural areas and tourist areas. The methods of net primary productivity estimation,
ecological footprint, supply and demand balance, comprehensive index evaluation and system model are commonly used to study the ecological bear capacity in a short period-individual time-event. As a result, there are many problems in the current research on environmental bear capacity, such as lack of scientific and complete research system, unclear indication meaning of threshold, insufficient in-depth research on dynamic evolution and prediction, and less involvement in spatial scale and pattern differentiation. The research results obtained are often isolated cases or short-term past results, which have little reference effect and are difficult to popularize quickly. However, in Wackernagel, which has the highest citation rate, M and six other researchers collaborated in the article "National natural capital accounting with the ecological footprint concept" published on ECOLOGICAL ECONOMICS. In this article, the author proposed that the yield of cultivated land in China is 1.66 by calculating China's ecological footprint, which has been adopted by many Chinese scholars in calculating the ecological bear capacity of cultivated land, indicating that the research on environmental bear capacity with more vitality and guiding significance should be widely applicable and applicable. The study of environmental bear capacity should widely absorb the theories of other sciences, including geography, economics, sociology, demography, anthropology and history, and look for new cognitive abilities, models and research methods, especially to study the historical changes of environmental bear capacity and the changes of environmental bear capacity in history from the perspective of human and environment and long-term history.

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